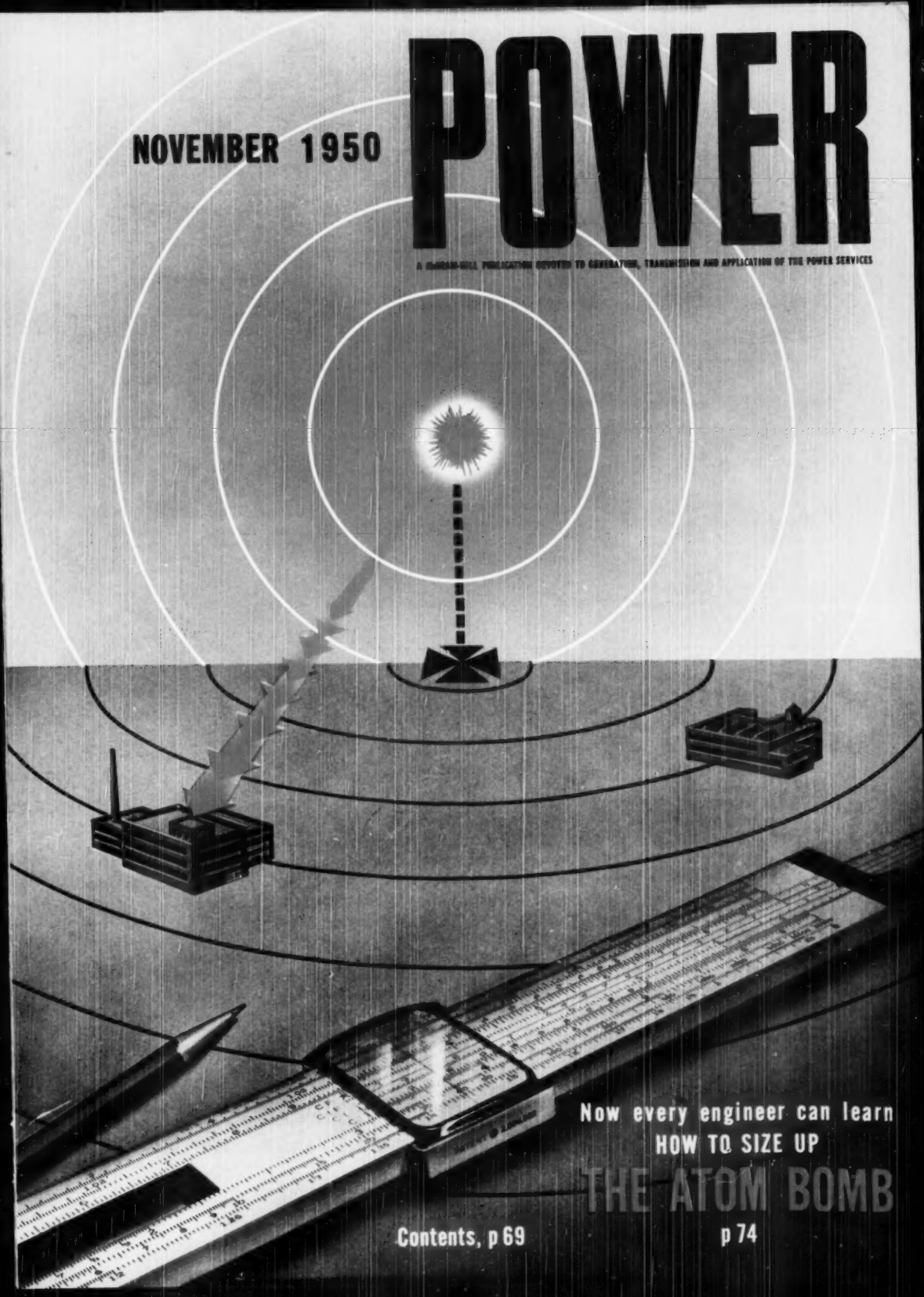
NOVEMBER 1950

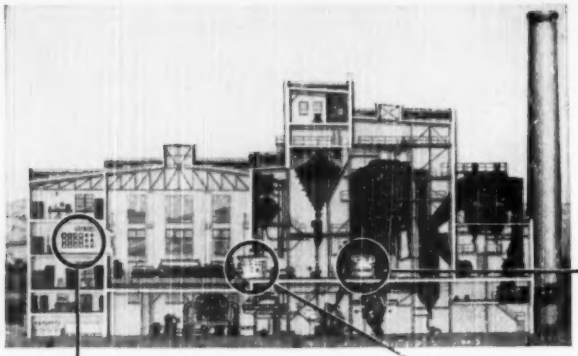
POWER

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES



Now every engineer can learn
HOW TO SIZE UP
THE ATOM BOMB
p 74

Contents, p 69



FOR BOILER BOARDS

Metermax Combustion Control
Micromax Superheat Control
Micromax Recorders for:
- **Per Cent CO_2**
- **Steam Purity**
- **Smoke Density**
- **Temperatures of steam, air preheater, economizer, flue gas, feedwater and other heat-balance points**

FOR ELECTRICAL BOARDS

Load-Frequency Control
Telemeters
Micromax and Speedomax Recorders for:
- **Frequency**
- **Voltage (A-C and D-C)**
- **Current (A-C and D-C)**
- **Power Factor**
- **Kilowatts**
- **Reactive Kva**
- **Temperature of bearings, rotors, stators, transformers, cables, etc.**

FOR TURBINE BOARDS

Micromax Conductivity Recorders for purity of condensate, etc.
Micromax and Speedomax Recorders and Indicators for temperature of condensate, cooling water, bearings, hydrogen cooler, etc.
Micromax pH Recorders and Controllers for feedwater treatment
Centrimax Flowmeter

Plant Efficiency--from Btu's to Megawatts--is Guarded by Dependable L&N Instruments

A KEY factor in obtaining accurate, high-availability performance of instruments and controls is the comprehensive line of L&N equipment for boiler, turbine and electrical control boards. Here are typical facts behind the widespread acceptance of these equipments in hundreds of plants:

Boiler Boards: Metermax Combustion Control pioneered the use of electric drive mechanisms in a unique electro-pneumatic control system . . . The Micromax CO_2 Recorder made automatic analysis of flue gas industrially practical . . . For temperature measurements, Micromax and Speedomax instruments and their primary elements are the result of over 38 years' experience.

Turbine Boards: Virtually every sizable steam plant relies on Micromax Conductivity Recorders for measuring condensate purity . . . The Centrimax Flowmeter is, to the best of our knowledge, the most accurate industrial flowmeter made today . . . Recording and control of pH, vital to feedwater treatment, was first made practical by the development of L&N equipment.

Electrical Boards: L&N Load Frequency Control and Telemeters today are operating in over 90 per cent of the interconnected systems in this country—regulating some 40 million kilowatts of generating capacity.

For details of how these and other L&N instruments can bring new dependability to your plant, contact our nearest office or write us at 4910 Stenton Avenue, Philadelphia 44, Pa.

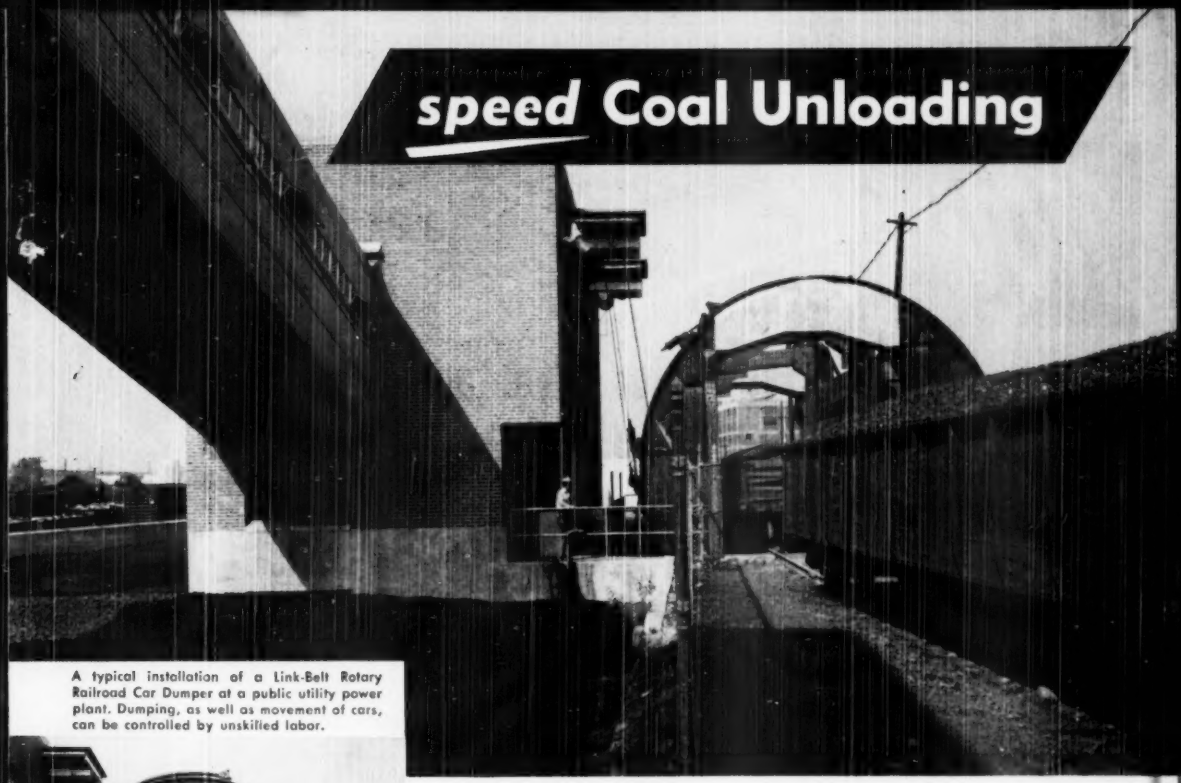
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jul. Ad. N-460(6)

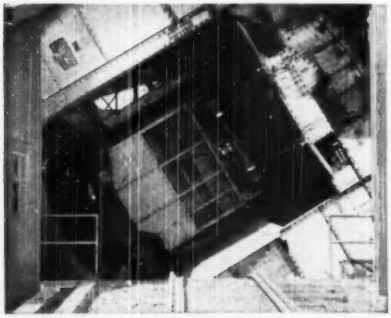
POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer" and "The Stationary Engineer"), November 1950, Vol. 94, No. 11. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter January 26, 1949, at the post office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. Subscription rates—U. S. and U. S. Possessions $5 for one year, $7 for two years, 65c per copy. Canada $7 for one year, $11 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years. Please indicate position and company connection on all subscription orders.

speed Coal Unloading



A typical installation of a Link-Belt Rotary Railroad Car Dumper at a public utility power plant. Dumping, as well as movement of cars, can be controlled by unskilled labor.

Thorough and immediate dumping is assured by completely inverting the car. Sturdy construction of all parts provides long life in this service with little maintenance and eliminates the necessity for alternate, stand-by equipment.



The unusual flexibility built into the Link-Belt Rotary Railroad Car Dumper permits the unloading of any size of all types of open-top cars without any adjustments by the operator.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Johannesburg. Offices in Principal Cities.

12,100

The Link-Belt Rotary Railroad Car Dumper fits into today's requirements for economy and speed in coal unloading at power plants. Any size of standard open-top railroad cars may be handled by this remarkably flexible and efficient machine which unloads a car by turning it upside down, assuring rapid and complete discharge, winter and summer. The dumper is so well balanced and counterweighted that its operation requires a minimum of power. A dumping cycle of a minute and a half is usually realized with a 40 horsepower motor, and more rapid operation can be accomplished with larger motors. The number of cars that can be dumped in a given time depends upon the switching and track facilities for delivering the loaded cars and removing the empties. Some installations handle 40 or more cars an hour. With such capacity no more than the one track hopper is required at most plants, even the largest, but the inherent economies of this type of unloading apparatus bring it within the reach of those with modest capacity requirements.

Because the Link-Belt Rotary Railroad Car Dumper is adaptable to existing and new plants, it will fit into your plans for improving coal handling methods. Our engineers will be glad to give you complete information concerning this machine and other coal handling equipment. Ask our nearest office.

LINK-BELT

COAL and ASHES HANDLING EQUIPMENT

now

Big boiler advantages "wrapped up" in NEW COST-SAVING B&W SHOP-ASSEMBLED UNIT

Here at last is the ideal combination for efficient, low-cost "packaged" steam: the new B&W Integral-Furnace Boiler, Type FM. It combines the many advantages of factory-assembled boilers with the service-proved economies of B&W Integral-Furnace construction. It's delivered fully-equipped for immediate operation.

Of prime importance is the fact that this new B&W boiler embodies design, construction, and operating features that have made larger capacity Integral-Furnace units such a heavy favorite among industrial plants and central stations.

Small and medium size plants, institutions, and commercial establishments will find this new unit the ultimate in low-cost heating and process steam-generation from 3,000 to 35,000 lb. per hr. at pressures to 250 psi. Large plants, too, where space and load characteristics warrant, may profitably consider several packaged boilers instead of a single "tailor-made" installation.

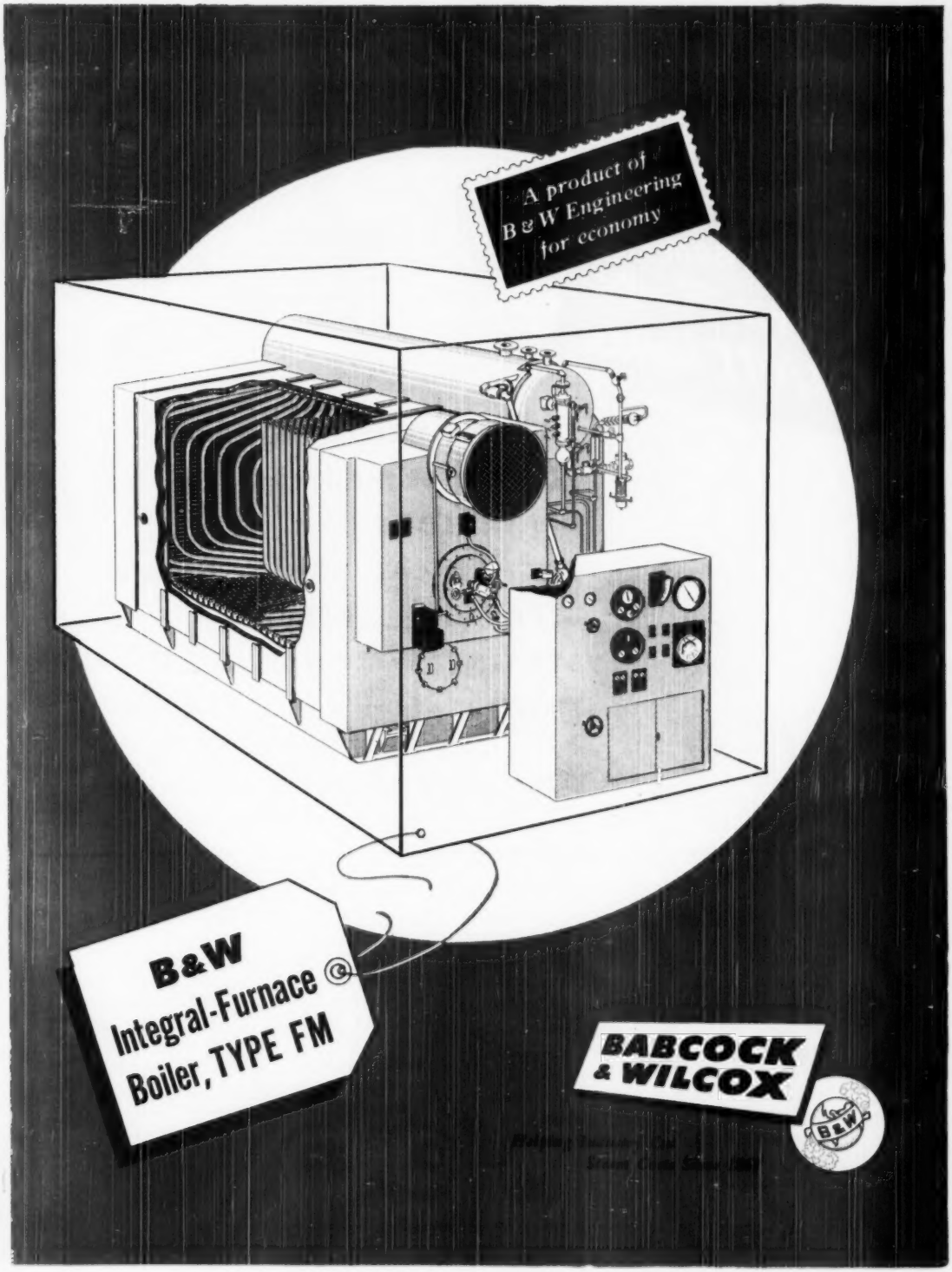
Engineered, designed and built under a single responsibility, the new Integral-Furnace Boiler, Type FM, is backed by the same tradition of service satisfaction that has made B&W a by-word in low-cost steam generation for over 80 years.

cost-saving features of the new B&W Integral-Furnace Boiler, TYPE FM

- Saves Erection Time and Cost
- Meets Wide Range of Services
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and /or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

Send for Bulletin G-72, detailing the many advantages of this new B&W creation in low-cost steam generation.

The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.


A product of
B & W Engineering
for economy
B&W
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Boiler, TYPE FM
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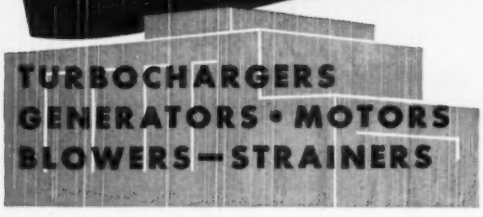

TURBOCHARGERS
GENERATORS • MOTORS
BLOWERS—STRAINERS

Almost everywhere that power is made and used, you may come upon the familiar Elliott plate identifying important equipment . . . With it, you will almost invariably find among executives and operating staff, a high degree of satisfaction in the performance of the unit so marked. Reliability as an Elliott characteristic is as soundly established as the equally vital quality of forward-thinking engineering which distinguishes Elliott products.

For Process Plants, ELLIOTT builds...

CENTRIFUGAL BLOWERS and BOOSTERS
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MOTORS • TUBE CLEANERS

For all kinds of Plants, ELLIOTT builds...

ELECTRIC MOTORS from 1 hp up
STRAINERS • TUBE CLEANERS

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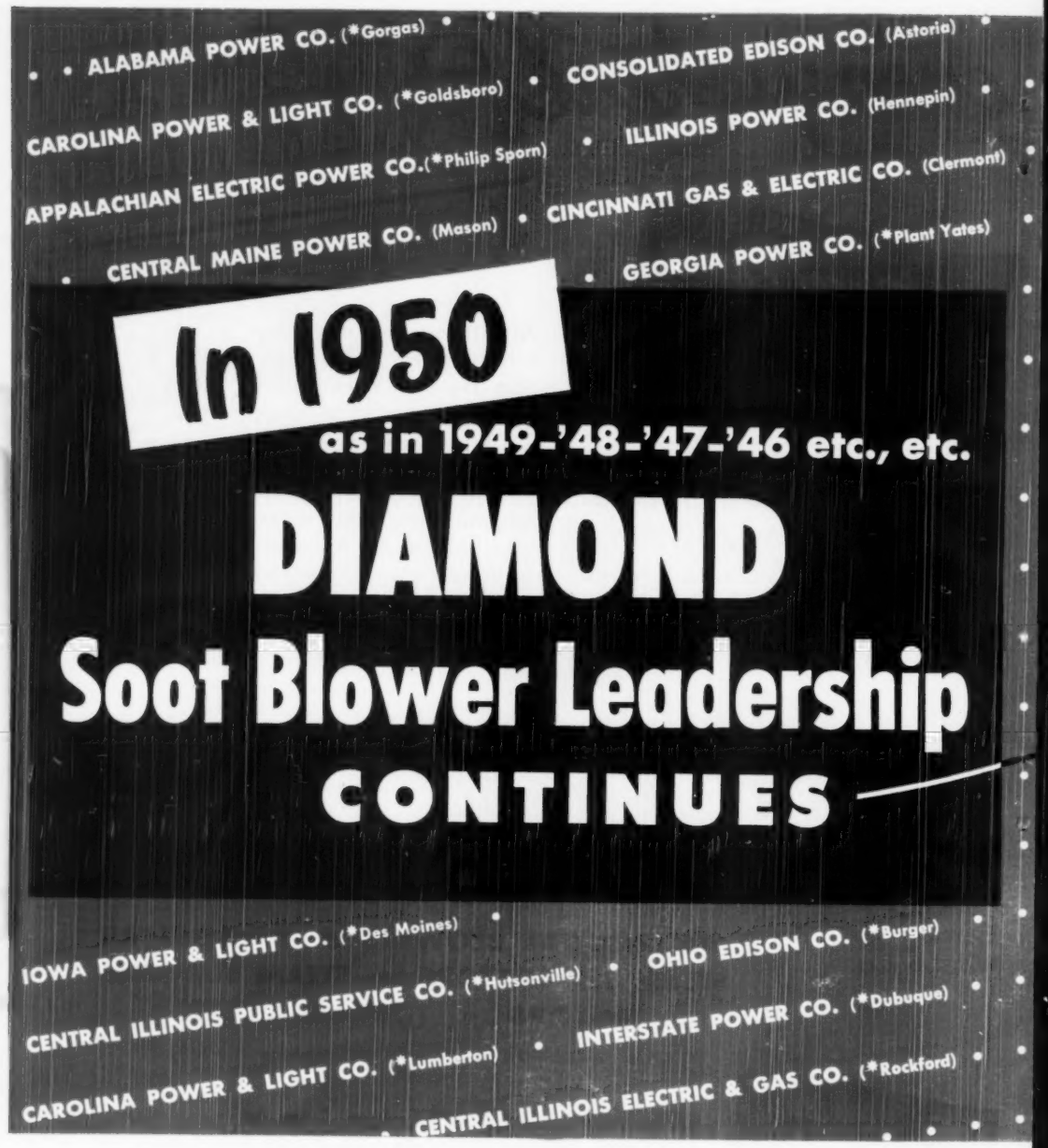
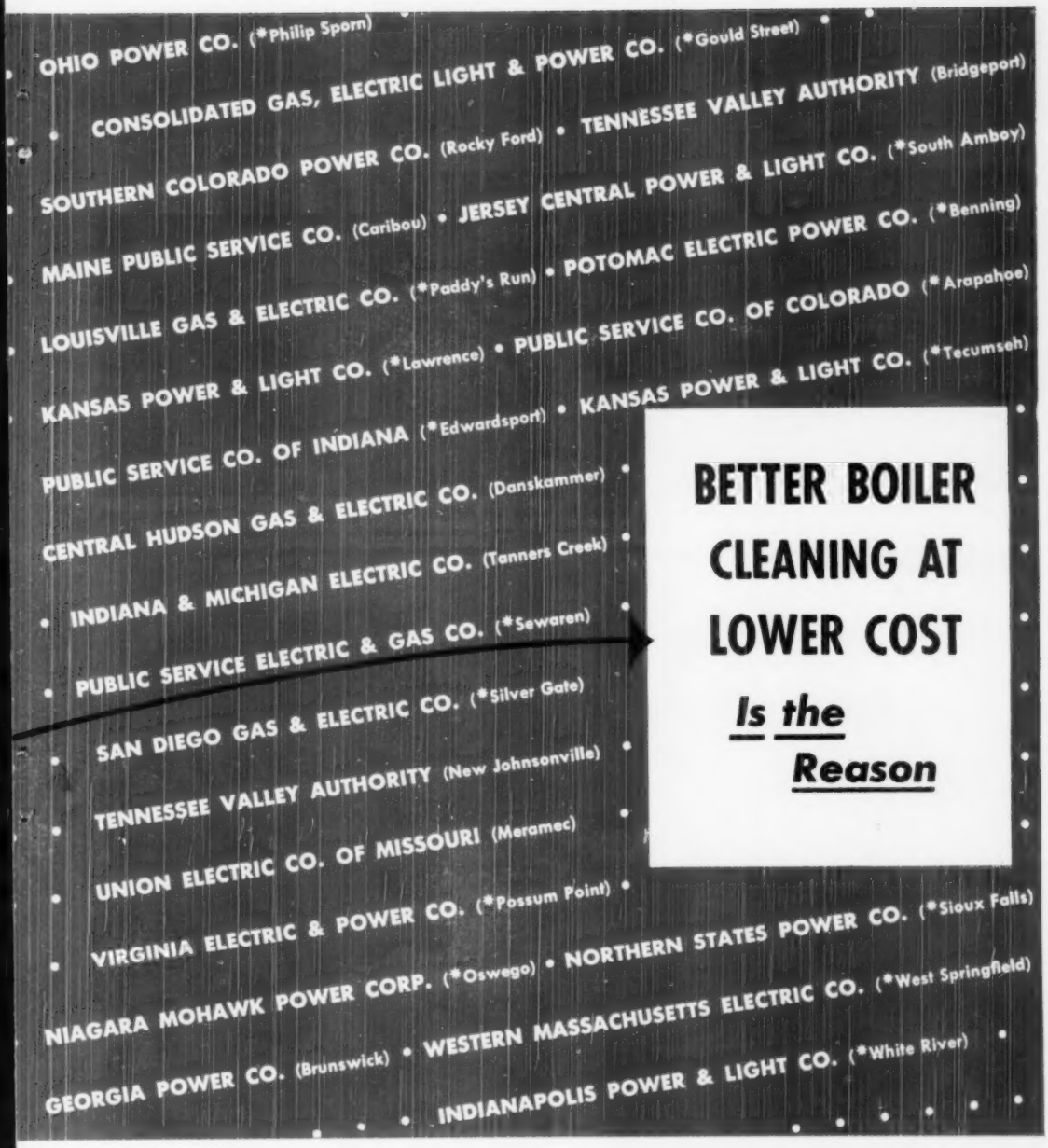

ALABAMA POWER CO. (*Gorgas)
CAROLINA POWER & LIGHT CO. (*Goldsboro)
APPALACHIAN ELECTRIC POWER CO. (*Philip Sporn)
CENTRAL MAINE POWER CO. (Mason)
CONSOLIDATED EDISON CO. (Astoria)
ILLINOIS POWER CO. (Hennepin)
CINCINNATI GAS & ELECTRIC CO. (Clermont)
GEORGIA POWER CO. (*Plant Yates)
In 1950
as in 1949-'48-'47-'46 etc., etc.
DIAMOND
Soot Blower Leadership
CONTINUES
IOWA POWER & LIGHT CO. (*Des Moines)
CENTRAL ILLINOIS PUBLIC SERVICE CO. (*Hutsonville)
CAROLINA POWER & LIGHT CO. (*Lumberton)
OHIO EDISON CO. (*Burger)
INTERSTATE POWER CO. (*Dubuque)
CENTRAL ILLINOIS ELECTRIC & GAS CO. (*Rockford)

*Repeat contracts for same station.

In 1950, as in '49, '48, '47, etc., leading public utilities are indicating nationwide preference for Diamond Soot Blowers. Conclusive evidence is in this list of central station contracts (complete steam generators only) above 600 psi for the first eight months of 1950. TODAY . . . as yesterday . . . Diamond Dominates in soot blowers.


OHIO POWER CO. (*Philip Sporn)
CONSOLIDATED GAS, ELECTRIC LIGHT & POWER CO. (*Gould Street)
SOUTHERN COLORADO POWER CO. (Rocky Ford)
TENNESSEE VALLEY AUTHORITY (Bridgeport)
MAINE PUBLIC SERVICE CO. (Caribou)
JERSEY CENTRAL POWER & LIGHT CO. (*South Amboy)
LOUISVILLE GAS & ELECTRIC CO. (*Paddy's Run)
POTOMAC ELECTRIC POWER CO. (*Benning)
KANSAS POWER & LIGHT CO. (*Lawrence)
PUBLIC SERVICE CO. OF COLORADO (*Arapahoe)
PUBLIC SERVICE CO. OF INDIANA (*Edwardsport)
KANSAS POWER & LIGHT CO. (*Tecumseh)
CENTRAL HUDSON GAS & ELECTRIC CO. (Danskammer)
INDIANA & MICHIGAN ELECTRIC CO. (Tanners Creek)
PUBLIC SERVICE ELECTRIC & GAS CO. (*Sewaren)
SAN DIEGO GAS & ELECTRIC CO. (*Silver Gate)
TENNESSEE VALLEY AUTHORITY (New Johnsonville)
UNION ELECTRIC CO. OF MISSOURI (Meramec)
VIRGINIA ELECTRIC & POWER CO. (*Possum Point)
NIAGARA MOHAWK POWER CORP. (*Oswego)
NORTHERN STATES POWER CO. (*Sioux Falls)
GEORGIA POWER CO. (Brunswick)
WESTERN MASSACHUSETTS ELECTRIC CO. (*West Springfield)
INDIANAPOLIS POWER & LIGHT CO. (*White River)
BETTER BOILER CLEANING AT LOWER COST
Is the Reason

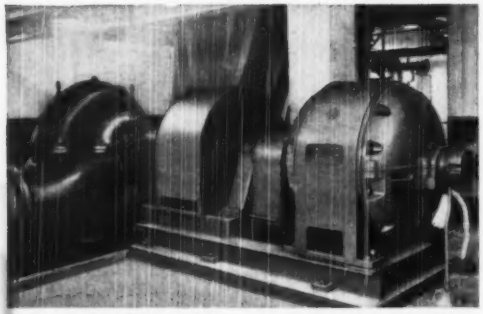
DIAMOND POWER SPECIALTY CORP.

Lancaster, Ohio

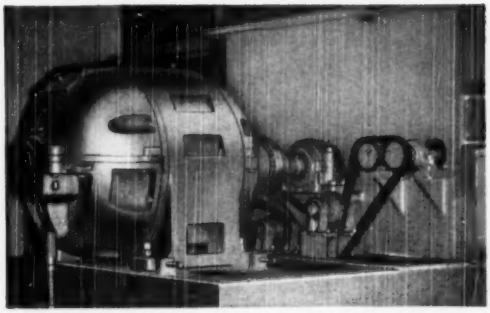
Canadian Plant – Windsor, Ontario

G-E SYNCHRONOUS

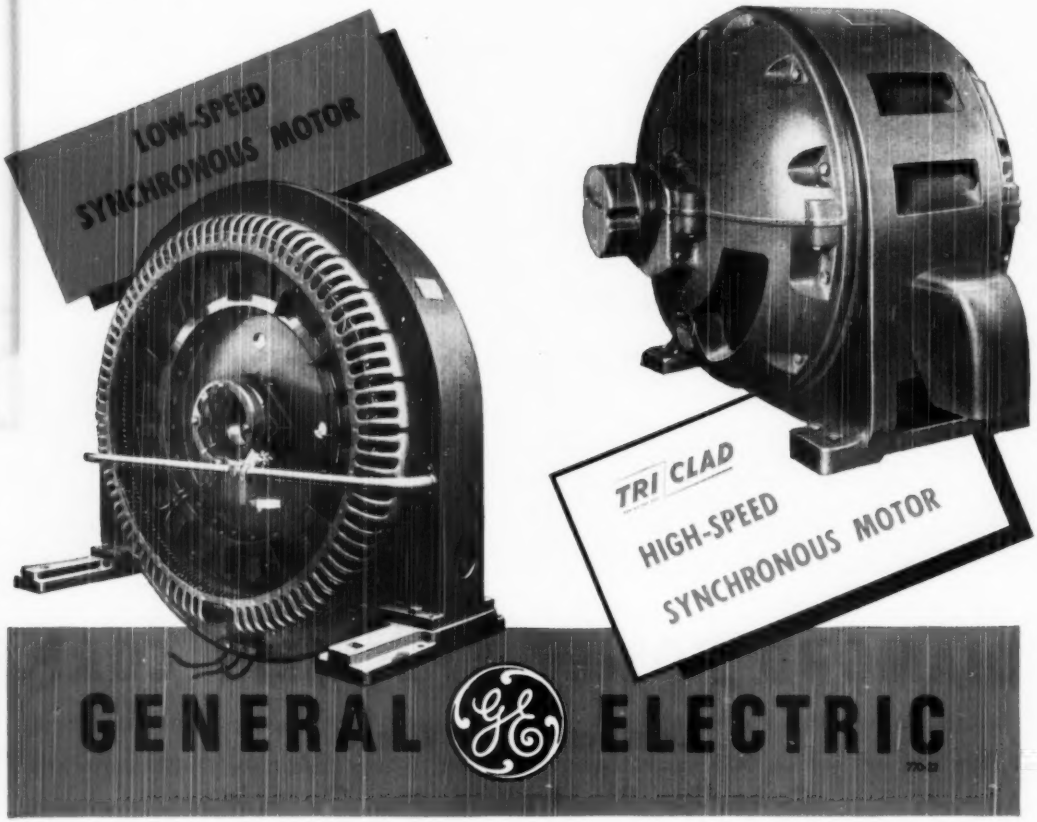
SAVE MONEY



SAVE ON OPERATING COSTS . . . Municipal plant gets higher efficiency by continuous operation at constant speed of three 500 horsepower, 1.0 power factor, G-E synchronous motors, each coupled to a centrifugal storm-sewer pump.



SAVE ON INITIAL COST . . . Paper mill selected this 4000 hp, 200 rpm, G-E synchronous motor for driving the montague grinders at low speed. Maximum operating efficiency thus resulted.



MOTORS CUT COSTS ...improve performance

IT'S ON THE RECORD...

Lower operating costs higher operating efficiency

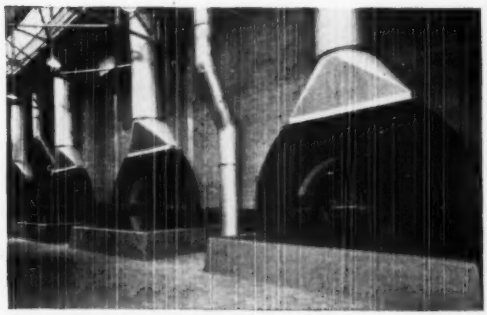
Lower initial cost including control and exciter—for many ratings

Reduced demand and release of needed generating capacity

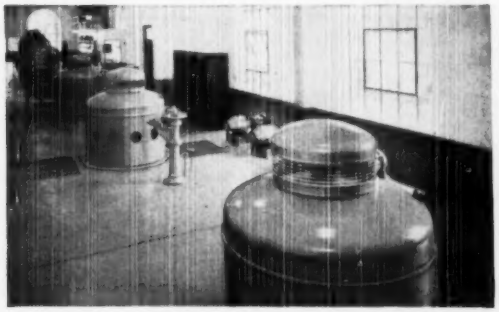
Reduced power rates for improved power factor

For your next large, constant-speed motor, ask your General Electric sales representative to tell you how you can take full advantage of the money-saving features of G-E SYNCHRONOUS MOTORS. Or write for bulletins GEA-5332 (low-speed) or GEA-5426 (high-speed) on your letterhead to *Section 770-22, Apparatus Department, General Electric Company, Schenectady 5, New York.*

GAIN EXTRA PERFORMANCE

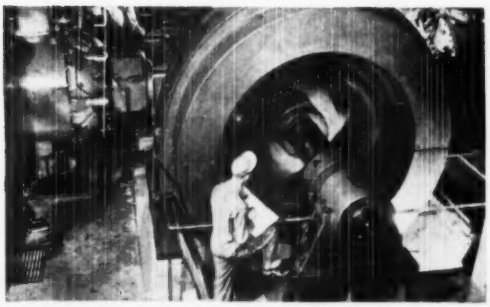


DEPENDABILITY . . . Extra protection against physical damage, electrical breakdown, and operating wear and tear makes Tri-Clad® motors highly suitable for sawmill operations. Here is a Tri-Clad synchronous motor rated 300 hp, 1200 rpm, driving an edger in an Oregon sawmill.



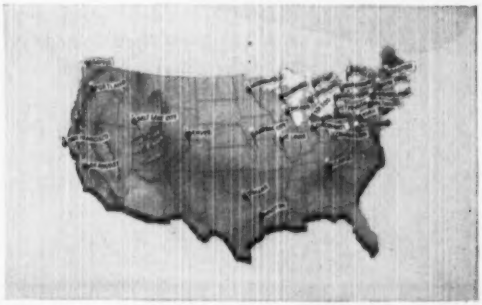
LONG LIFE . . . All welded steel-plate stators assure a permanently solid core, and box-type construction means a rigid frame. This 350 hp, 0.8 p.f. G-E synchronous motor, coupled through magnetic clutch, is matched to a fan pump which delivers stock to paper machine.

SIMPLIFY OPERATING PROBLEMS



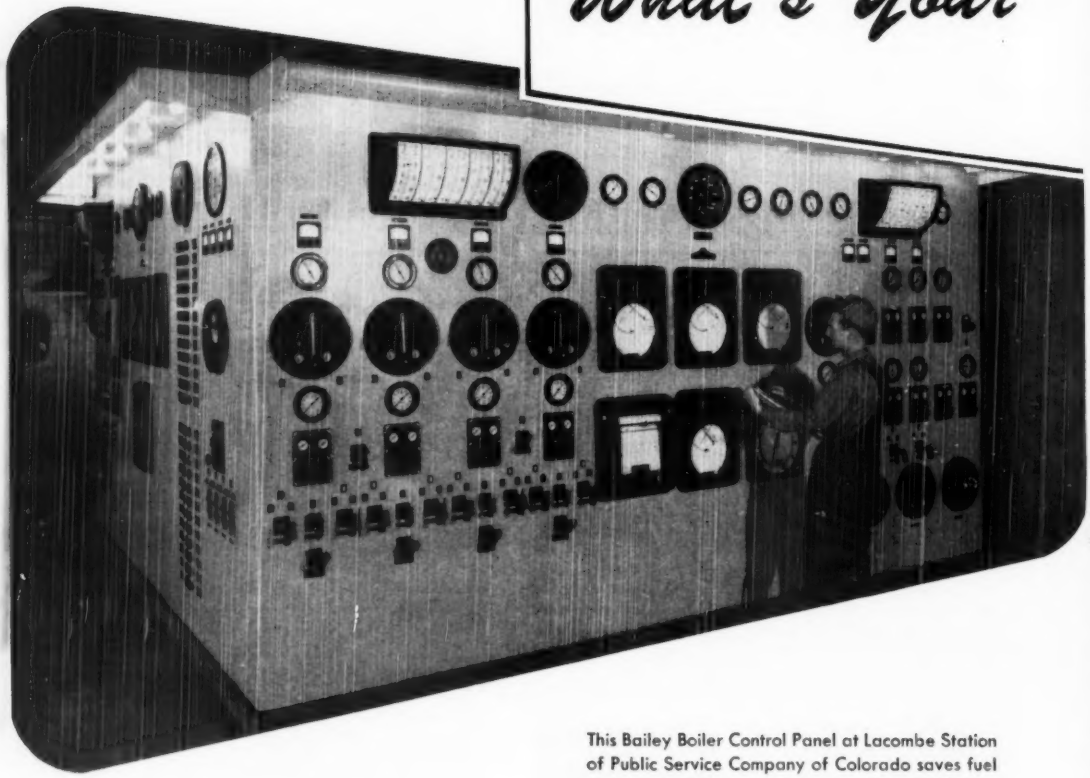
APPLICATION ENGINEERING . . . Engineers with many years of field experience will tailor synchronous motors to fit your needs. An example is this largest synchronous motor (in horsepower) ever to be applied to drive a reciprocating compressor; G-E motor rated 4500 hp, 300 rpm, driving a Clark gas compressor.

®Reg. U. S. Pat. Off.



SERVICE . . . No matter where your plant is located, you will find General Electric service close at hand. Experienced engineers of our local offices, and trained staffs from our Service Shops are always at your command.

What's Your



This Bailey Boiler Control Panel at Lacombe Station of Public Service Company of Colorado saves fuel and insures safe operation of a 350,000 lb per hr 850 psi, 900 F boiler fired by pulverized Colorado Lignite Coal and/or natural gas.

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Control-Dollar Efficiency ?

Control-dollars frequently bring annual investment returns of 100% or more. When you buy adequate, well-applied steam plant controls, you increase your dollars' ability to work usefully for you.

That's where Bailey can help: Bailey Controls can give you a better control-dollar efficiency. Here's why:

1. Complete Range of Equipment — fully co-ordinated. You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell — or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service — backed by experience. No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service — conveniently located near you. Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For better control-dollar efficiency — for more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-112-2

BAILEY METER COMPANY

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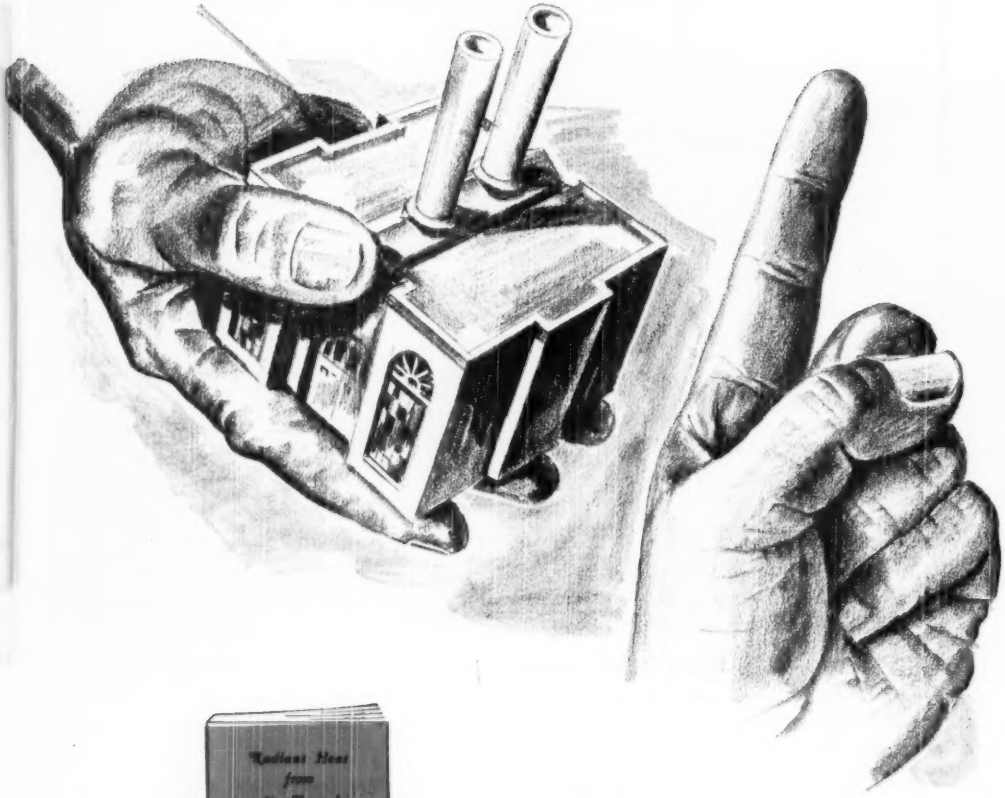
BAILEY METER COMPANY LIMITED • MONTREAL, CANADA

BAILEY METERS

HERE'S YOUR PLANT COMPLETE



Send for a copy of Engineering Bulletin No. 44-B containing valuable information on steam generation and coal pulverization.

ANYWHERE YOU WANT IT

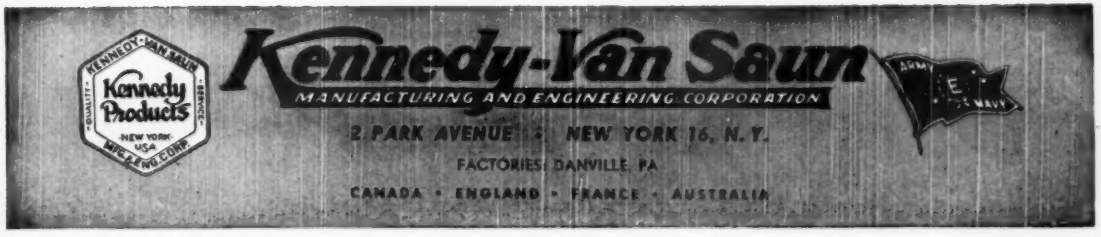
designed and built under ONE *responsibility* KVS

YOU tell us the conditions and we'll do the rest.

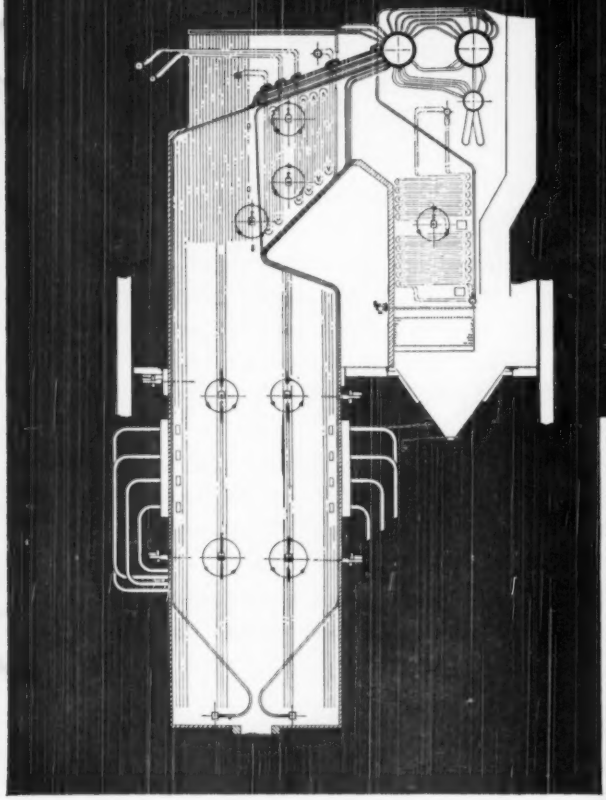
Aside from our facilities for designing complete power plants and erecting them in any part of the World, KVS stands in the unique position of building these plants for operation on lowest grades of fuel. Thus low cost power is assured from such fuels as tailings, washings, screenings, etc. Successful, economical performance of KVS equipment on such fuels has been demonstrated over and over again.

In addition to equipment built in its own shops, KVS will supply and erect all other components necessary to the installation of a *complete* plant . . . from "bunker to bus bar". This service is offered under KVS responsibility and fully guaranteed by KVS for overall performance.

May we suggest you discuss your conditions and needs with KVS engineers who are fully competent to advise, recommend and follow through wherever your contemplated plant is to be erected.

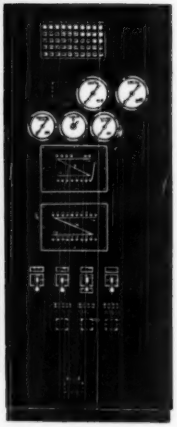


VULCAN at Outstanding New



BOILERS:

Two Combustion Engineering-Superheater Steam Generators, each with a rating of 670,000 pounds per hour at 1492 psi and 1000 TST.

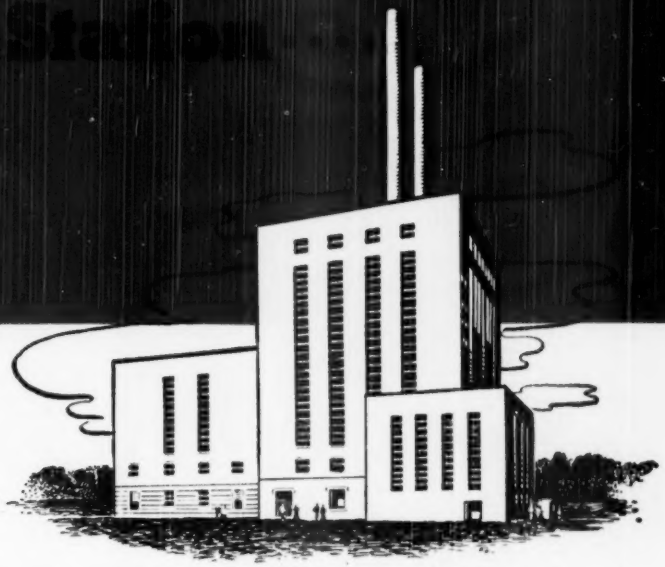


PANEL:

Automatic sequential operation of the entire Vulcan Soot Blower System is controlled from this central panel.

VULCAN Automatic

BUFFALO NIAGARA
Dunkirk Station



33 Vulcan Soot Blower units will be installed in each of Dunkirk Station's two 1492-psi C-E Steam Generators, including:

20—RW-1 Air-Motor-Driven Wall Deslaggers

8—T-2 Air-Motor-Driven Long Retractables

5—Air-Motor-Driven Vulcomatic Rotary Units.

Vulcan Automatic controls will also operate the Ljungstrom air preheater blowers.

Whether the blowing medium be air, as at Dunkirk, or steam —or both—the top design and operating engineers find in Vulcan's advanced engineering today's best buy for the really tough cleaning jobs.

Write for Bulletin 483. It tells you how Vulcan Automatic Sequential Soot Blowers will keep your boilers clean, and cut your soot-blowing costs.

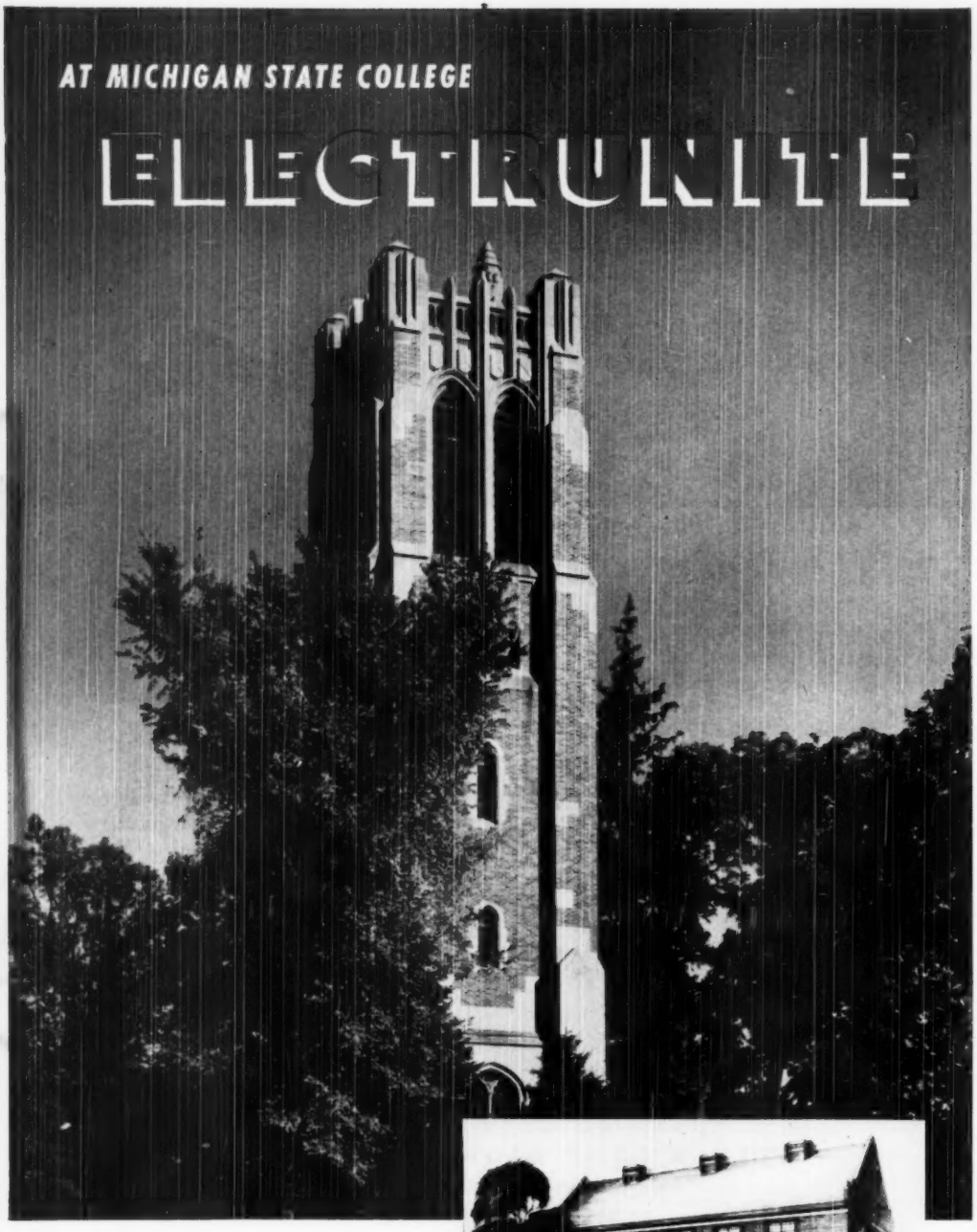
VULCAN SOOT BLOWER DIVISION

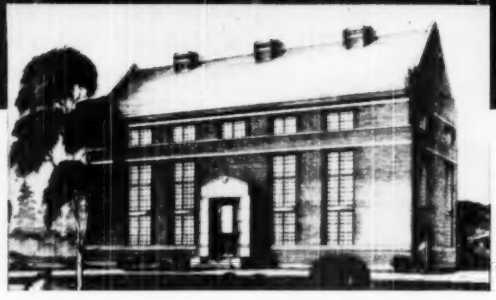
Continental Foundry & Machine Company

DUBOIS, PENNSYLVANIA

AT MICHIGAN STATE COLLEGE

ELECTRONIC





Symbol of Michigan State College, Beaumont Tower stands on the site of historic College Hall, erected in 1856. This was the first building in America, erected expressly for agricultural teaching.

This attractive steam generating plant houses the eleventh Wickes Boiler installed at Michigan State College—provides space for future 12th unit.

BOILER TUBES

meet greatly expanded steam requirements in eleventh Wickes Boiler installation

● Forerunner of all land grant colleges, Michigan State College ranks among America's leading institutions of higher education. Its present enrollment—approximately 15,000 students—is more than double that of any prewar year.

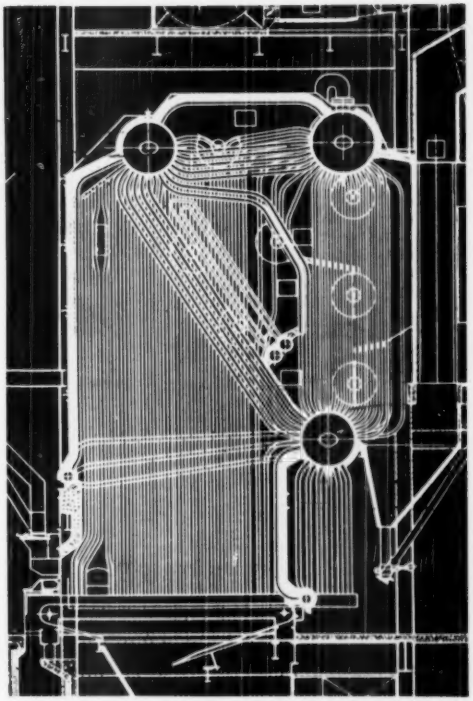
Included in a gigantic $30,000,000 postwar expansion and building program, necessitated by the upsurge in enrollments, is a modern steam generating plant containing the *eleventh* Wickes Boiler installation at the Michigan State campus.

Here, again, Republic ELECTRUNITE Boiler Tubes were installed as original equipment in the 125,000 lb. per hour boiler shown in the diagram at the right. Here, too, ELECTRUNITE Boiler Tubes again demonstrated the ease of installation and dependable performance characteristics which make them a favorite with manufacturer and maintenance man alike.

ELECTRUNITE Boiler Tubes are easy to install and easy to maintain because they are made from flat-rolled steel, cold-formed and electrically welded into sound, scale-free tubing. They are consistently uniform in diameter, concentricity, wall thickness and high ductility . . . they bend, slide through and roll in without difficulty.

Now, before you retube or order new equipment, is the time to get the complete story about long-lasting ELECTRUNITE Boiler Tubes. Write today for your free copy of Booklet BT-10.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

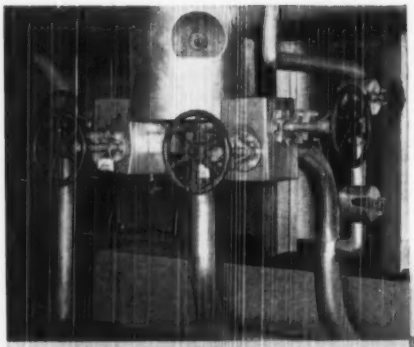


Boiler specifications: capacity, 125,000 lb. steam per hour; design pressure, 350 psi; total steam temperature, 550°F.

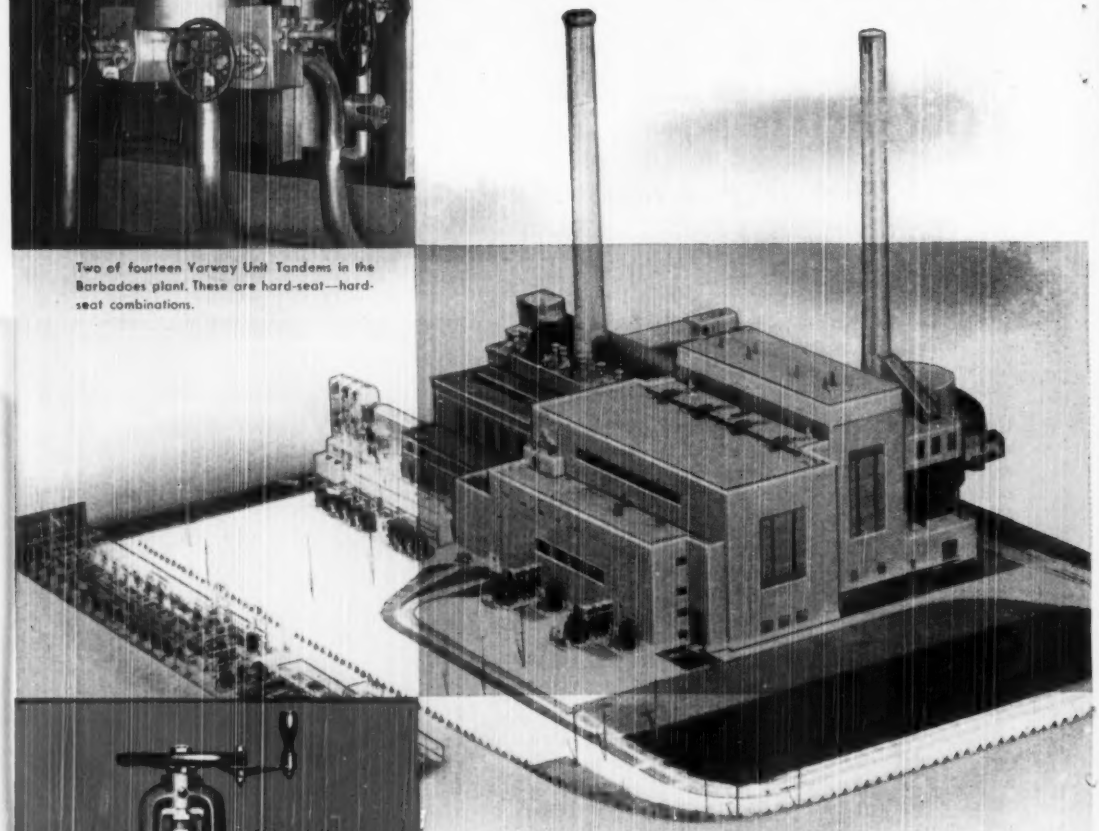
Booth 13

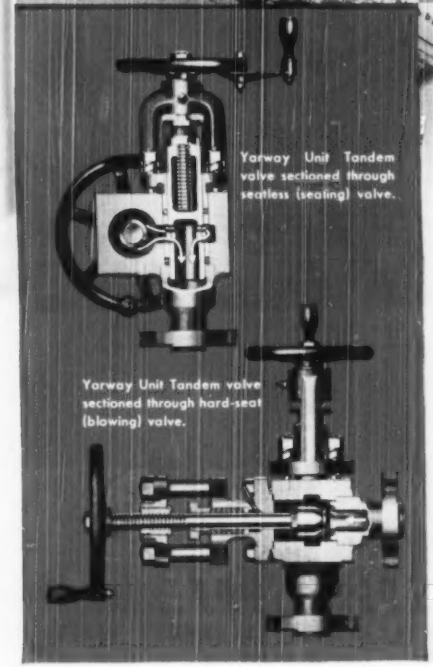
Republic
REPUBLIC STEEL
ELECTRUNITE
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

BARBADOES BOILERS GET



Two of fourteen Yarway Unit Tandems in the Barbadoes plant. These are hard-seat—hard-seat combinations.





Yarway Unit Tandem valve sectioned through seatless (sealing) valve.

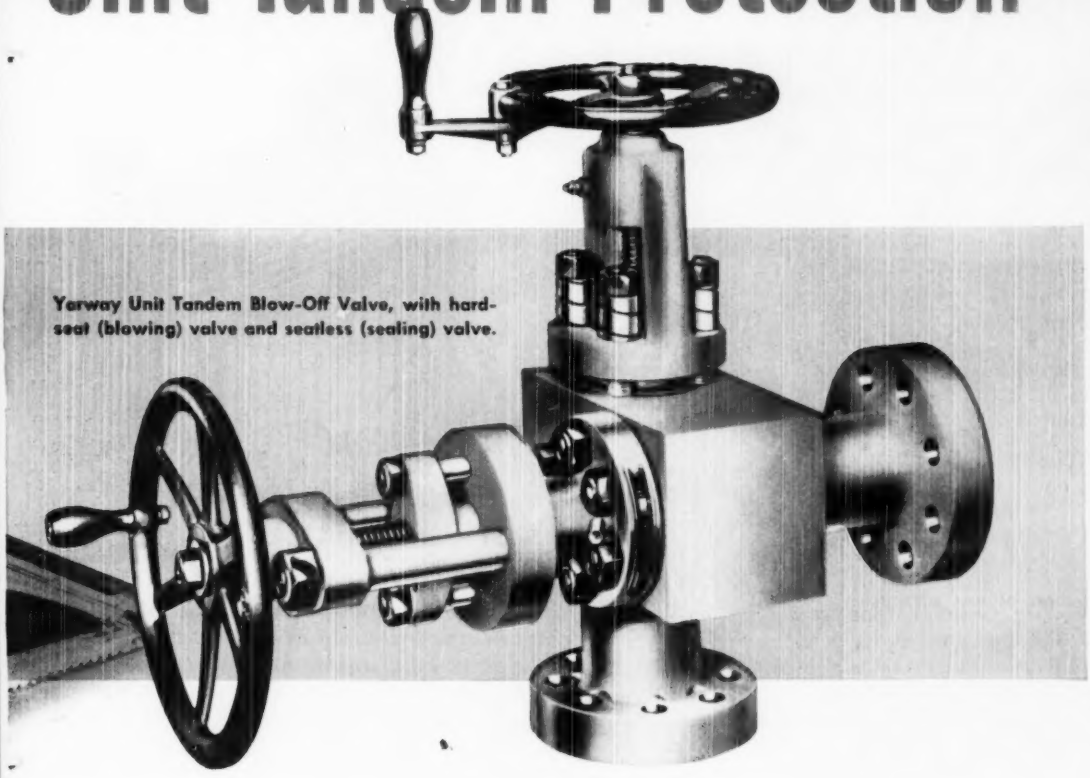
Yarway Unit Tandem valve sectioned through hard-seat (blowing) valve.

When a company has a $25,000,000.00 stake in the future such as Philadelphia Electric Company does in its Barbadoes Station—then protects the boilers of that plant with Yarway Unit Tandem Blow-Off Valves—it's significant of the dependability of those valves.

Barbadoes is a fine example of modern power plant engineering, demonstrated by the fact that only 11 men per shift are needed for operating this 180,000 KW station.

YARWAY

Unit Tandem Protection



Yarway Unit Tandem Blow-Off Valve, with hard-seat (blowing) valve and seatless (sealing) valve.

Yarway Unit Tandem Blow-Off Valves also are a good example of steam equipment engineering—used in more than 4 out of 5 high pressure boiler plants in the country.

Rugged construction makes Yarways strong and tough enough to withstand severest blow-down conditions. Metallurgical improvements make them resistant to the reactions of periodic acid wash. *Outages are rare where Yarway boiler valves are used.*

Unit tandems are available in various combinations to meet all pressure and service requirements.

Write for Bulletin B-433 for full details on Yarway Unit Tandems. For lower pressure blow-off valves, write for Bulletin B-424.

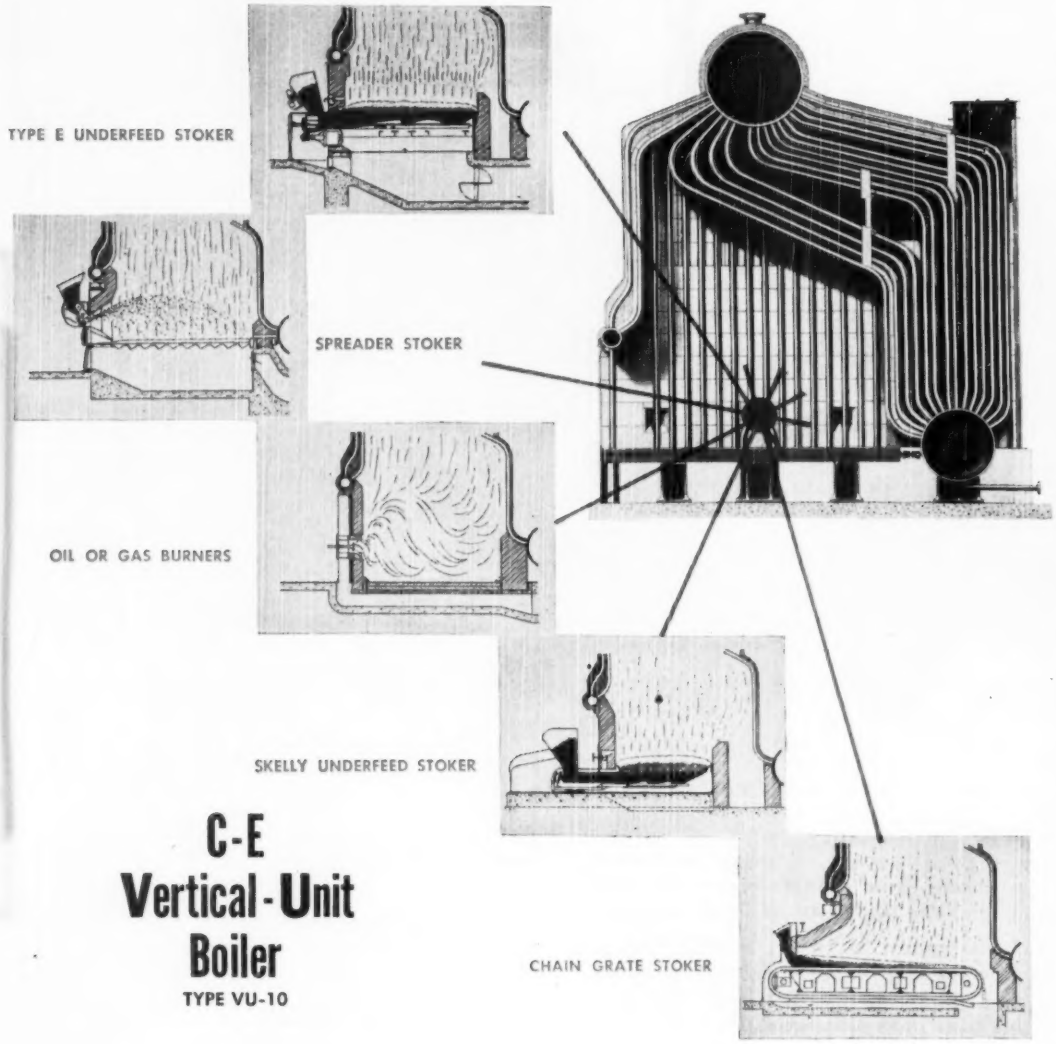
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

See Yarway Products at the National Power Show, Grand Central Palace, New York, November 27 to December 2. Booths 65 and 66.

STEAM PLANT EQUIPMENT

For every fuel market and every type of load there is *one best* method of firing. The selection of that *one best* method for the fuel and load conditions of a particular plant calls for judgment based on broad experience and free from any incentive to favor one type of fuel burning equipment over another.

The Type VU-10 Boiler is designed for five fully standardized methods of firing—spreader stoker, single-retort underfeed stoker, chain grate stoker, oil or gas burners. The furnace design is such that any of these methods may be substituted for any other should a change in the fuel market make it advantageous.



C-E Vertical-Unit Boiler

TYPE VU-10

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

Why buy a Boiler Unit piecemeal?

A piecemeal boiler unit is one in which some of the major components are purchased from different manufacturers.

There is no assurance . . . certainly no protecting guarantee . . . that the resulting assembled compromise will meet your performance requirements. If you buy piecemeal, you must accept the uncertainties inherent in divided responsibilities for overall results.

That is why it will pay you to investigate the Vertical-Unit Boiler, Type VU-10. Here is a completely integrated unit . . . boiler, water-cooled furnace, setting and fuel burning equipment . . . available from one manufacturer — Combustion Engineering—Superheater—a recognized leader in both the fields of fuel burning and steam generation. From the initial design stage, the relationship of each of the components, one to the other, has been so developed as to provide the highest possible degree of correlation and standardization. And . . . of prime importance to the buyer . . . the overall performance is underwritten by the C-E sales policy of "one contract, one guarantee, one responsibility."

So—buy *your* next boiler as a *complete* unit . . . the VU-10. Enjoy the peace of mind that comes from the knowledge that you have an installation for which one manufacturer—Combustion Engineering—Superheater — is responsible for fulfillment of performance guarantees. Moreover, you will be able to count upon a reliable source for whatever service or spare parts you may require during the many years that represent the useful life of a modern steam generating unit. B-440

— SUPERHEATER, INC.
200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

● THE MUNICIPAL ELECTRIC PLANT
of MUSCATINE, IOWA

Knows the Value of *Automatic*

Republic automatic boiler control and instrument panels at Muscatine Municipal Electric Plant

Republic regulator controlling fuel feed to stokers.

Control

● In 1941 the Municipal Electric Plant at Muscatine, Iowa, installed a modern 100,000 lb. per hr. steam generator. In 1948 a second boiler rated at 160,000 lb. per hr., 650 psi. was added.

In any steam electric generating plant, electric power rates and steam cost go hand-in-hand. Low steam cost however, is not the result of efficient boiler design alone. It is determined by the degree with which your method of boiler control takes full advantage of those economies which have been "built-in" the boiler and its auxiliaries.

To realize all the operating advantages of these modern boilers, each was equipped with a Republic automatic combustion and feed water control system at the time of installation. Built into the Republic control system are the many important features that enable it to fulfill all the conditions of theoretically perfect boiler control and still meet all the demands of everyday operation.

The installation of Republic automatic controls on your boiler (or boilers) will enable you to: —

SAVE FUEL by automatically maintaining highest combustion efficiency.

INCREASE STEAM OUTPUT by operating the boilers at test efficiency 24 hours a day, 7 days a week.

CONSERVE MANPOWER by automatically performing the many routine repetitive adjustments.

REDUCE OUTAGES by maintaining uniform operating conditions and thereby prevent the chain-of-event type of trouble that frequently develops as a result of incorrect boiler operation.

An automatic boiler control system, as designed and built by Republic, will help you meet today's need for more steam at lower cost.

Find out about Republic control systems. One of our engineers will be glad to consult with you at any time. Write us today.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

"We stopped both useless shutdowns and motor burnouts from Single Phasing by installing Fusetron fuses in a refrigeration compressor circuit"

Glenn F. Buschman, Manager
Kirby Risk Electric Motors, Inc.
Lafayette, Ind.

Mr. Buschman continues—

"In December '47 we rewound a motor for the Rund Packing Company of Lafayette, Indiana that had been burned out on single phase.

"One week later the same motor came back, again burned out on single phase.

"We investigated and found that the motor was used on the refrigeration compressor and that starting currents were causing the 100 amp. 250 volt renewable fuses protecting the circuit to blow. When one of them blew it single phased the motor.

"The thermals in the starter were oversize and so the motor burned up.

"100 amp. FUSETRON dual-element fuses were installed in place of the ordinary fuses and the thermals changed to the proper size.

"The thermals have so far never had to operate because the FUSETRON dual-element fuses stopped the useless blows on the starting current. This automatically stopped the single phasing that had previously caused the motor burnouts."

FUSETRON FUSES GIVE 10-POINT PROTECTION

TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION

BUSS

★ Fusetron fuses have high interrupting capacity. Tests conducted by the Electrical Testing Laboratories of New York City in December 1947 showed that on a 240 volt 60 cycle 3 phase, 4 wire circuit set to deliver 50,000 amperes, 30, 60, 100, 200, 400 and 600 ampere 250 volt Fusetron fuses on each and every test cleared the circuit without belching flame and with comparatively little noise.

1. ★ Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

Fusetron DUAL-ELEMENT Fuses

Give All-Purpose Protection

because . . .

The fuse link element opens on short-circuit — the thermal cutout element protects on overloads — the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses — fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

Don't Risk Losses

One needless shutdown
One lost motor
One destroyed switch or panel

may cost you far more than replacing every ordinary fuse with a FUSETRON dual-element fuse

MAIL THE COUPON NOW
for complete information about Fusetron Fuses and their 10-point all-purpose protection

Bussmann Mfg. Co., University at Jefferson St. Louis 7, Mo.
(Division McGraw Electric Co.)

Please send me complete facts about FUSETRON Dual-Element FUSES.

Name.....

Title.....

Company.....

Address.....

City & Zone..... State.....

750

This man *can help you*

control temperatures accurately—economically

19TH NATIONAL EXPOSITION
OF POWER AND MECHANICAL ENGINEERING

November 27-December 2
1950
Booth 324-326
Grand Central Palace
New York

He's the man who can show you the proper insulation to give maximum heat and power for each fuel dollar expended

An Eagle-Picher Industrial Insulation distributor or representative can help you reduce operating expenses because he has available a wide line of insulation products—for high and low temperatures—scientifically designed for maximum thermal efficiency, and practical application. Why not let him give you more information about some of the products listed here?

These Eagle-Picher products can save you money . . . power . . . time

Insulating Felts • Supertemp Blocks • Blankets • Loose Wool
Pipe Covering • Stalastic • Insulseal • Insulstic • Swetchek
Finishing Cements • Insulating Cements • Fireproofing Cement
Diatomaceous Earth Blocks

EAGLE EP PICHER
Since 1843

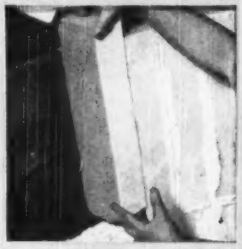
THE EAGLE-PICHER COMPANY
General Offices: Cincinnati (1), Ohio

Insulation products of efficient mineral wool—for a full range of high and low temperatures. Technical data on request.

2188

Here's one insulation that will save you money

EAGLE-PICHER DIATOMACEOUS EARTH BLOCKS #85 and #95



A highly efficient, rigid-type insulating material composed almost entirely of pure, lightweight, Eagle-Picher Diatomaceous Earth. High physical strength enables these blocks to stand up well under the handling and usage normally encountered in installation. Adaptable to virtually all types of heated equipment. Can be cut with a knife or saw to fit irregular shapes. DE-85 Blocks for temperatures to 1300° F. DE-95 Blocks for temperatures to 2000° F.

These efficient, versatile insulations "team up" to give perfect insulation for every major application

You can't beat the teamwork of Eagle-Picher Super "66" Insulating Cement, Eagle-Picher Insulseal and Eagle-Picher Insulating Blocks (Supertemp Blocks, Diatomaceous Earth Blocks No. 85 for temperatures up to 1300° F., and Diatomaceous Earth Blocks No. 95 for temperatures up to 2000° F.). They work effectively to give your equipment highest possible thermal efficiency . . . cut operating costs by saving the maximum amount of fuel . . . and help to provide perfect, precise control over temperatures.

EAGLE-PICHER SUPER "66" INSULATING CEMENT

Super "66" is all-purpose, rust-inhibitive, extremely adhesive insulating cement. "Springy ball" pellets don't collapse after application . . . give great coverage, retain their thermal efficiency. 100 lbs. covers 65 sq. ft.—1 inch thick. Easily applied with trowel, over flat and irregular surfaces. Efficient for temperatures up to 1800° F. Reclaimable when used on equipment whose temperatures do not exceed 1200° F.

EAGLE-PICHER SUPERTEMP BLOCKS

Eagle-Picher Supertemp Blocks are lightweight (approximately 16 lbs. per cu. ft.). Can be cut easily with knife or saw to fit off-shaped areas . . . they fit snugly over minor irregularities. They're strong and have high refractory value. Withstand temperatures up to 1700° F. Conductivity at 512° F. approximately 0.43 . . . all standard sizes, from 3"x18" to 12"x36" in thicknesses from 1" to 4".

EAGLE-PICHER INSULSEAL

A tough, weatherproof, protective coating for insulation. For temperatures up to 450°F. Applied as a plastic, its smooth troweling qualities assure uniform coverage, proper thickness. It protects insulation from air infiltration, fumes, rain, snow, vibration, punctures, and withstands severe service, indoors or out. Dries to a smooth, rich black, has a neat appearance on hot or cold surfaces . . . may be washed or painted.

THE EAGLE-PICHER COMPANY General Offices: Cincinnati (1), Ohio

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Stalastic • Insulseal • Insulstic • Swetchek • Finishing Cements
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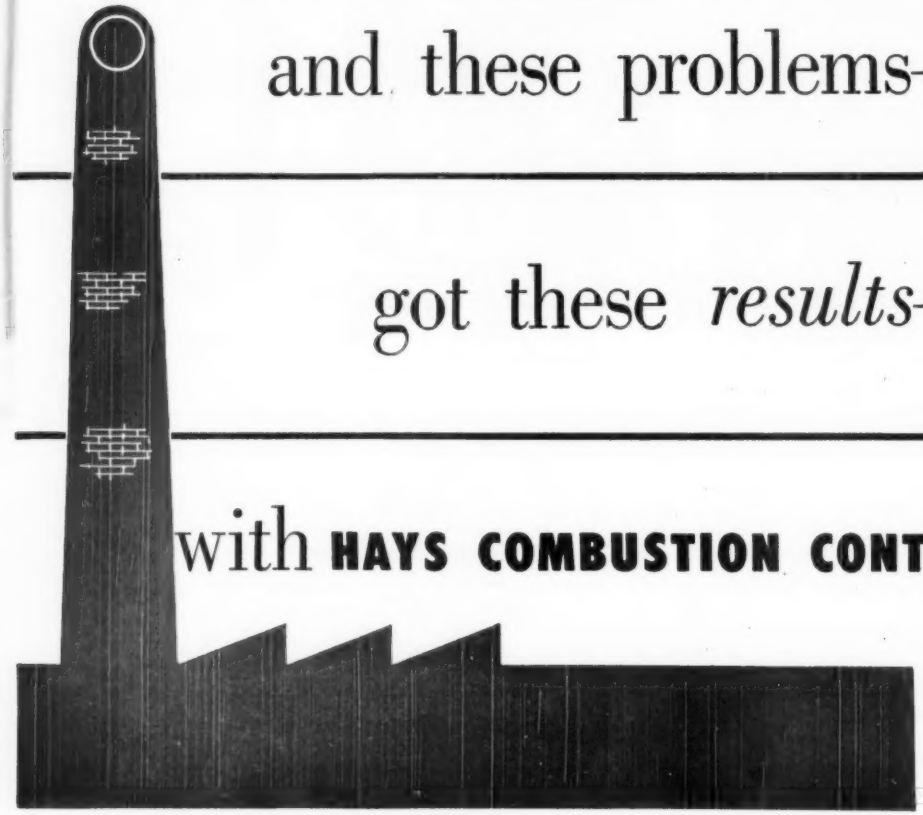
these leading companies →

with these conditions

and these problems →

got these *results* →

with **HAYS COMBUSTION CONTROL**



	AMERICAN TOBACCO COMPANY	SHERWIN-WILLIAMS COMPANY	RAYBESTOS-MANHATTAN COMPANY	BEMIS BROS. BAG COMPANY	SUNSHINE BISCUIT COMPANY
no. of boilers	Three (one stand-by)	Three	Four	Two	One, plus steam generator incinerator
rating	16,500 lb per hr	65,000 lb per hr	19,650 lb per hr	70,000 lb per hr and 80,000 lb per hr	31,500 lb per hr
load	Varies from 40-50,000 lb per hr total fluctuation up to 20,000 lb per hr	75,000 max. each boiler	120,000 lb per hr in winter—70,000 lb per hr in summer	68,000 lb per hr in winter, 60,000 lb per hr in summer. Daily variation 15,000 lb per hr	From 10,000 to 30,000 lb per hr
fuel	Coal	Coal	Coal	Oil and coal	Oil
use of steam	Power and process	Process and space heating	Mostly for process, also for pumps, compressors and heating	Power, process and heating	Process
	1. To recondition or add new boiler 2. Better process load regulation	Combustion efficiency	To get better efficiency. To get more out of boilers due to rising load	Accurate control of pulverized coal and oil firing through wide load swings	To lower costs. Drastic load fluctuations
	(1) "The Hays instruments and controls, through greater efficiency . . . gave us the solution . . . that of increasing steam capacity" and (2) "regulating the steam that goes into process."	"Operating efficiency has been as high as 82%—much of the credit going to the accuracy of (Hays) automatically controlled combustion."	"Our basic reason for installing the Hays control was to obtain better efficiencies. Our aim was more than reached . . . efficiency . . . 79.3%."	"We have made test runs using the Hays automatic combustion control system, bringing the load rapidly up from 8,000 lb per hr to 80,000 lb per hr with excellent results."	"Our management and operating crew are well pleased with the new (Hays) unit, not only because of the low maintenance costs but also because the equipment enables us to keep close watch over our operating costs."

compare your control requirements and write for the results story which matches your needs—free on request

THE HAYS CORPORATION *MICHIGAN CITY 3, INDIANA* • Automatic Combustion Control • Boiler Panels •

Hays-Penn Flowmeters • Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages • Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

Sweet's File

S

power plants

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mechanical equipment	2
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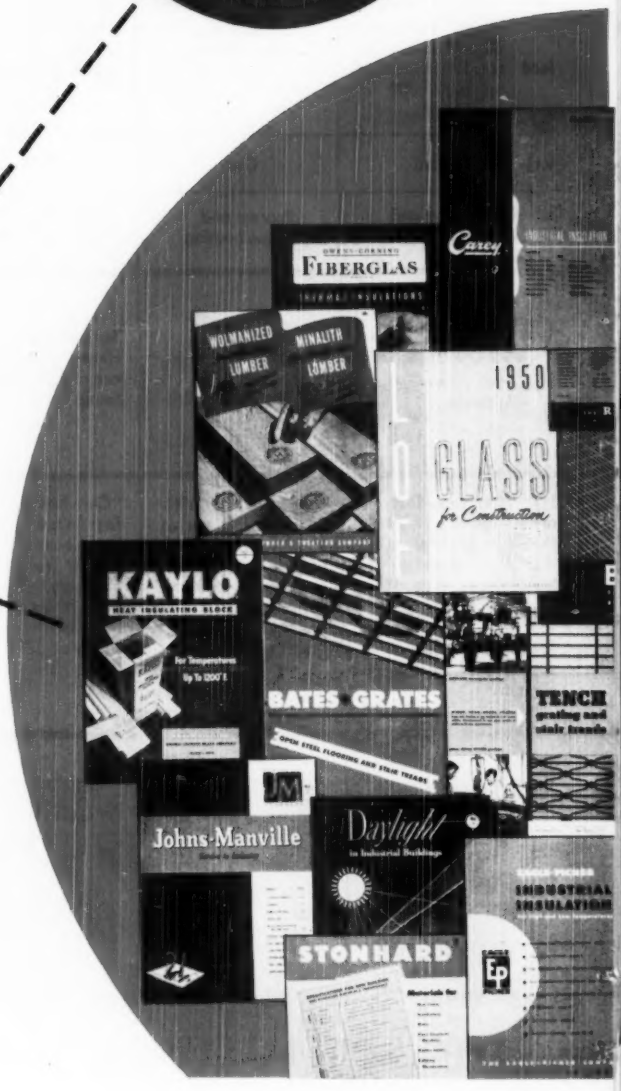
special services	7

1950

looking for materials?

reach for Sweet's **... All these manufacturers' catalogs — containing comprehensive information on glass, thermal insulation, refractories, roofing and siding, waterproofing and dampproofing, flooring, paints and finishes — are instantly available in Section No. 4 of your Sweet's File for Power Plants.**

The other sections of this Sweet's File contain additional catalogs covering a wide range of equipment and supplies ... useful and up-to-date information on product forms, characteristics, performance and use.

This grouping of manufacturers' catalogs, in sections according to products or use of products, is made for your convenience, so that you can more readily compare one product with another. Indexes of manufacturers, products and trade names lead you quickly and easily to the catalogs you are looking for.

Sweet's is working constantly to get more manufacturers to send you their catalogs in this easy-to-use form. If you fail to find what you want, please tell us.

Sweet's catalog service

DIVISION OF
F. W. DODGE CORPORATION
119 WEST 40th STREET
NEW YORK 18, N. Y.

No Other Water Conditioning System Has All of These Features...

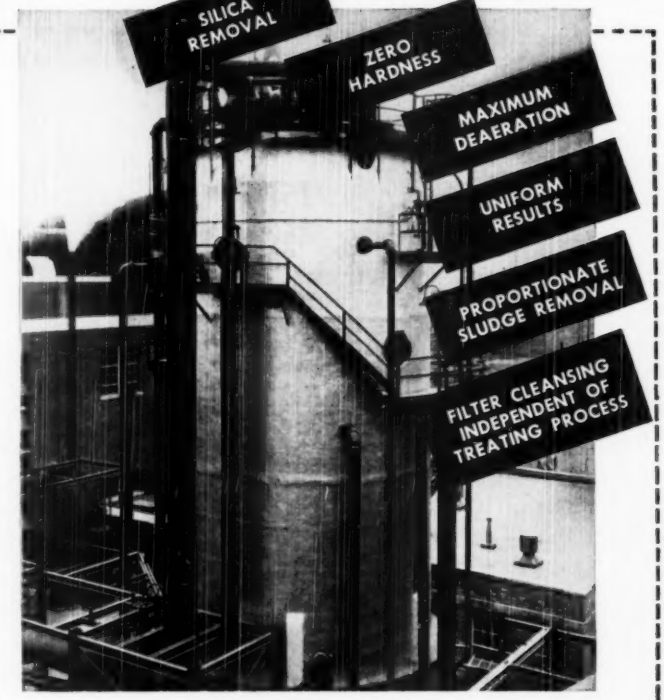
...ALL IN ONE TANK:

YES, you get all these and more, too, in one tank without the aid of internal mechanical agitation or other moving parts when a water conditioner like this 900,000 lb. per hour Worthington installation treats your make-up or condensate water.

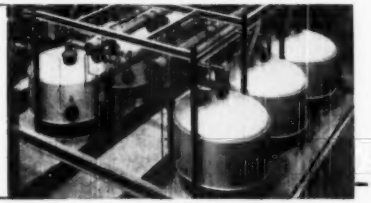
In less space you get all the heating, chemical feeding and clarification facilities to provide optimum water conditioning results. Worthington's engineering skill and complete manufacturing facilities offer you the advantages which can only result from carefully coordinated effort under one responsibility.

WRITE FOR FACTS

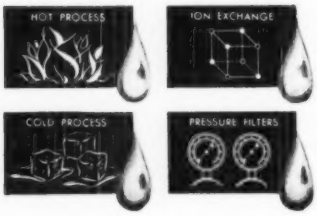
For proof that, in water conditioning as in so many other services, *there's more worth in Worthington*, write for Bulletin W-212-B2. *Worthington Pump and Machinery Corporation, Water Treating Division, Harrison, N. J.*



Main treating tank of a Worthington Hot Process Water Conditioning System, capacity 900,000 lb. of treated water per hour



Six pressure filters 11 feet in diameter used for final clarification in this Worthington Hot Process Water Conditioning System



WORTHINGTON

WATER CONDITIONING

Worthington Makes More *of the Equipment For All Types of Water Conditioning Systems*

TRI CLAD MOTORS
REG. U.S. PAT. OFF.
will run safely without relubrication for as long as any general-purpose motor you can buy—
and if the application makes relubrication a *must*, you can grease a TRI CLAD *without* halting production
GENERAL ELECTRIC
HERE'S WHY

TRI CLAD MOTORS will run safely without relubrication for as long as any general-purpose motor you can buy—

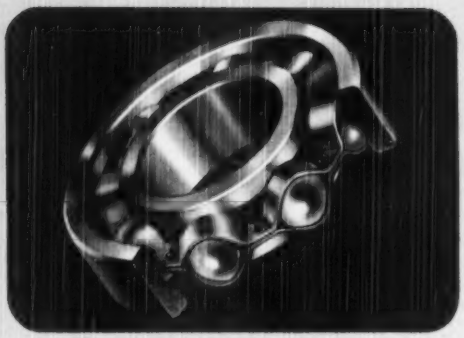
Tri-Clad extra lubrication "protection" can save you money because:

1. Tri-Clad's oversize grease reservoir and the heaviest standard-service bearings mean you do not have to bother with greasing between motor check-ups.

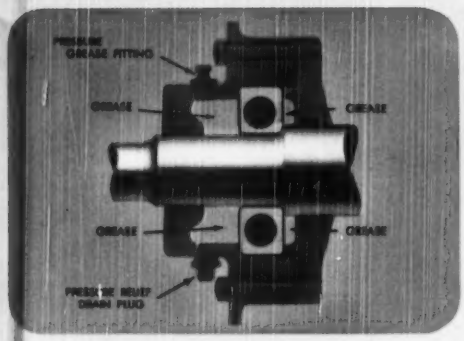
2. When relubrication is needed on those tough applications, you can grease a Tri-Clad without interrupting production-line operations.

Tri-Clads are grease-gun easy to lubricate *on the job*. Moreover, a Tri-Clad motor will run safely where an ordinary motor would fail. Chances are you'll be spared the cost of a "special" motor.

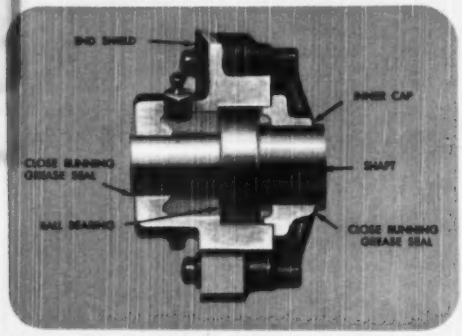
YOU BE THE JUDGE! The best way to prove to yourself that Tri-Clad gives you the most for your motor dollar is to contact your local G-E office. Tri-Clad stocks are complete. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



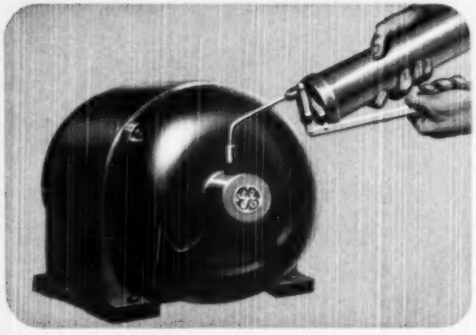
1 **EXTRA BEARING PROTECTION** — Tri-Clad gives you extra bearing protection because heaviest standard-service bearings are carefully selected to withstand severe loads for long periods.



2 **EXTRA GREASE** — Four times the ordinary amount of grease is packed into the large Tri-Clad grease reservoir. Since bearing life depends on grease, this means that Tri-Clad motors will run safely for years — for as long as any general-purpose motor you can buy.



3 **SEALED-IN BEARINGS** — Bearings and grease are completely sealed in a cast housing with long running seals for extra protection from dirt, dust, and lubricant leakage.



4 **PRESSURE-RELIEF GREASING** — An efficient system of pressure-relief lubrication (with standard fittings) enables a Tri-Clad motor to be quickly and easily greased on the job when and if it's needed.

GENERAL ELECTRIC

732-3

The TERRY TURBINE

TURBINES FOR *Air Conditioning* AT MADISON SQUARE GARDEN

In 1925 Madison Square Garden installed three Terry Multi-Stage Turbines to drive air conditioning and refrigeration compressors. These units deliver 290 hp at 3500 rpm with steam conditions of 100 psi exhausting to a 26 in. vacuum.

After 22 years experience Madison Square Garden installed three more Terry Multi-Stage Turbines, one of which is shown above. This unit delivers 330 hp, at 5650 rpm, with steam at 100 psi exhausting to a 25 in. vacuum.

The same engineering talent and manufacturing facilities that produced these turbines are available to assist you in obtaining efficient power generation.

Any of our District Representatives will be pleased to give you full information on a turbine drive for your requirements. No obligation. May we send you descriptive bulletin?

TT 1184

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Announcing

Centr-A-Power

... custom-built ... pre-engineered

New Features Save Floor Space, Speed Up Wiring, Facilitate Operation

LESS FLOOR SPACE NEEDED

Compact trough design allows more troughs to be used in a given area of floor space.

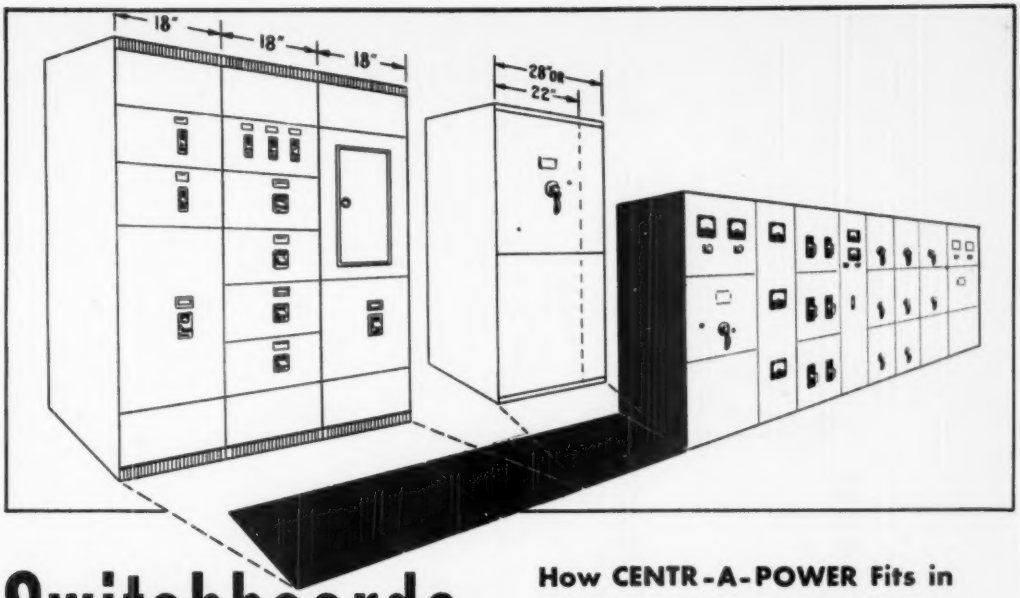
LOTS OF ROOM FOR WIRING

Generous (4 x 8 in.) wiring gutter makes wiring easier —can be accomplished with units in the trough—and allows use of over-size cable on long runs, keeping voltage drop low.

ACCESSIBLE FROM FRONT

CENTR-A-POWER Switchboards are completely accessible from the front, permitting aisle, back-to-back, "L" and "U" installations, further saving floor space.

TRUMBULL'S TRAINLOAD OF NEW PRODUCTS



Switchboards

. . . at money-saving prices

To save you money on installation time and maintenance costs, Trumbull has designed a new type of switchboard for complete low voltage (600 V and under) switching requirements. Because of pre-engineering and standardization, you can now have the highest quality construction at the lowest possible cost. Here are some of the features:

Pre-fabricated, rigid steel troughs can be placed in any arrangement to provide a completely dead-front, totally-enclosed switchboard. Wiring gutter design is such that load wiring is isolated from incoming load bus. Compact switch or breaker units, called CENTR-A-PLUGS, are easily mounted or removed. A quick-clip attachment saves time in installation, inspection and maintenance. Self-aligning latches replace bolts and nuts. Positive connection to bus bars is assured by use of spring-loaded, reinforced stabs. Each CENTR-A-POWER unit self-contained and electrically isolated from adjacent units.

How CENTR-A-POWER Fits in with Your Present Rigid Type Switchboard Equipment

CENTR-A-POWER is made from three standard troughs, all 90 in. high. At left is unit type CENTR-A-POWER with 18 in. trough; it handles fusible switches through 200 amp. and circuit breakers through 600 amp. Two standard section troughs are indicated in the center. Type A is 22 in. wide, handles 400 and 600 amp. fusible switches. Type B is 28 in. wide, handles fusible switches through 1200 amp. and circuit breakers through 1600 amp.

Unit-Type Troughs (18 in.) are furnished assembled or unassembled. Large standard sections are furnished assembled only.

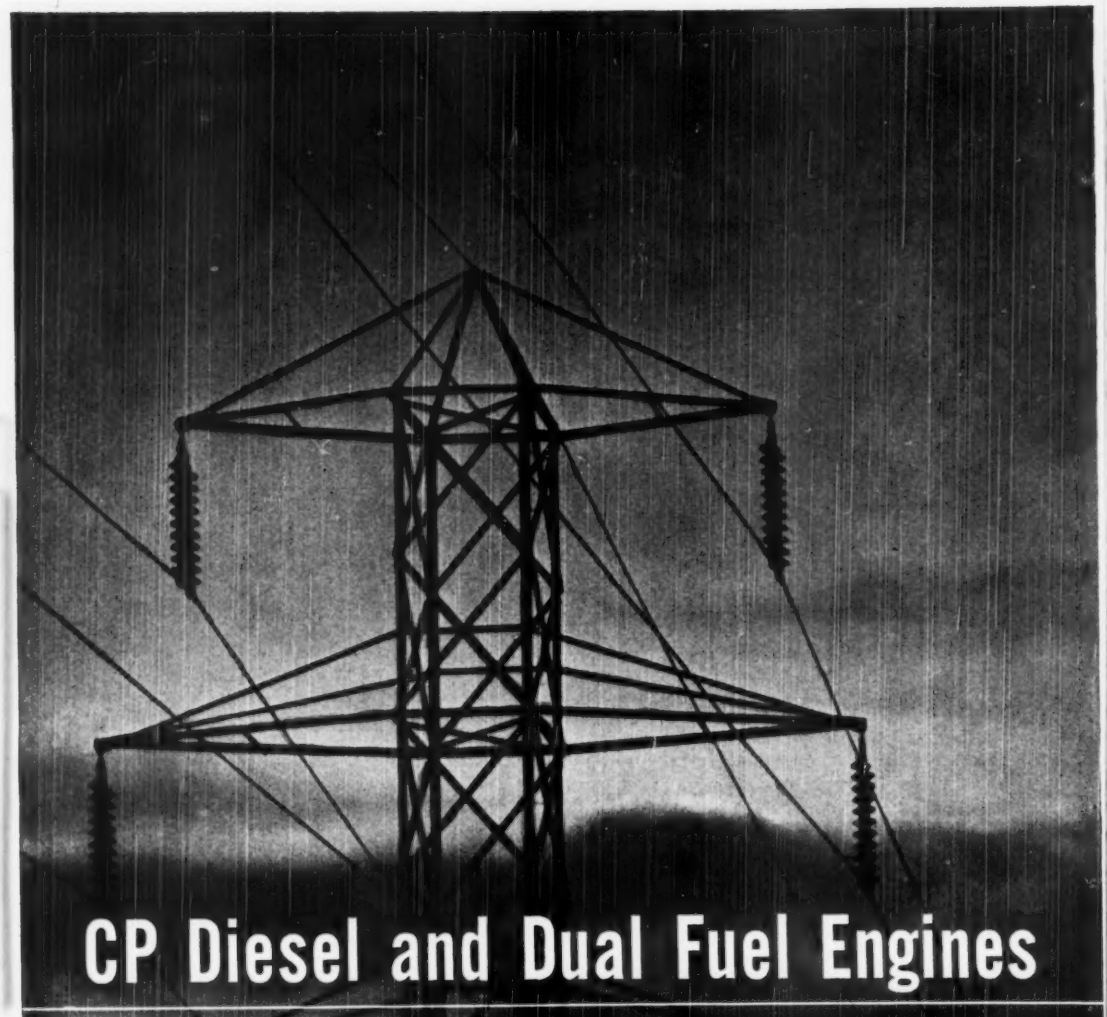
ASK ABOUT TRUMBULL CENTR-A-POWER CONTROL CENTERS

which are of similar construction and line up mechanically and electrically with CENTR-A-POWER Switchboards.

New Free Bulletin—Address The Trumbull Electric Manufacturing Company, Plainville, Conn. Ask for Bulletin TEB-3.

TRUMBULL (T) ELECTRIC

TRUMBULL'S TRAINLOAD OF NEW PRODUCTS



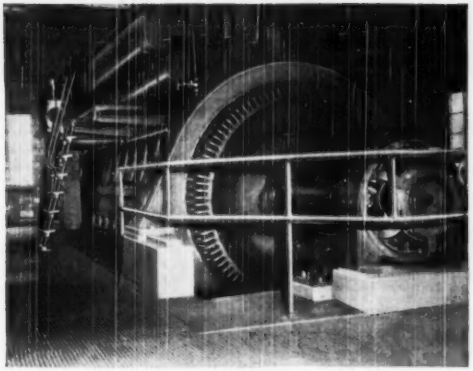
CP Diesel and Dual Fuel Engines

for every Public Utility purpose

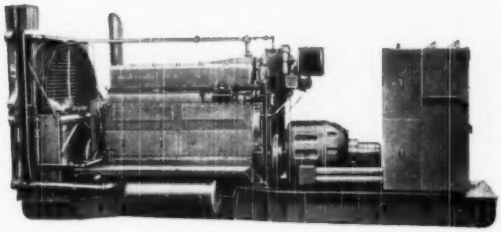
Available in sizes from 120 to 1750 horsepower, CP engines can be furnished either for straight Diesel or Dual Fuel operation. The CP line includes both normally aspirated and supercharged engines, all the latter incorporating the thoroughly dependable Elliott-Buchi Turbo-charger.

The engines illustrated are typical of many CP installations in public utility service.

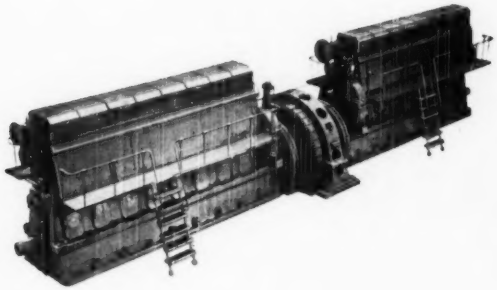
Write for further information



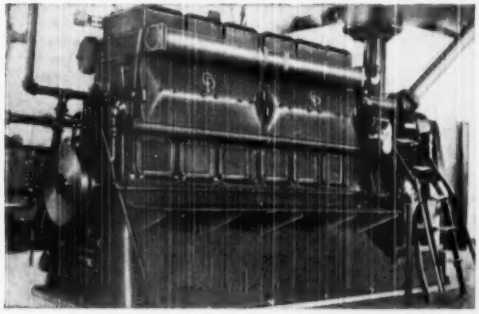
1650-hp Dual Fuel Generator unit in public utility plant – 327 rpm, 1150 kw.



500-kw CP Portable Generator unit for public utility emergency service.



Twin Engine Generator unit rated 2250 hp, 1500 kw.



A 175-kw Diesel Electric unit in a prominent utility plant, with more than 14,000 hours service to date.

CHICAGO PNEUMATIC TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

Select Your Steel Valves

Edward GAGE VALVES 600 lb sp

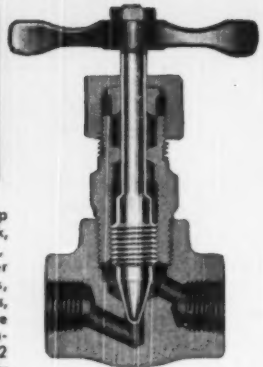


Fig. 152

FIG. 152 SERIES—A drop forged, instead of bar stock, steel valve for gage, meter, dead-end, instrument and other small lines, and for pumps, vents, Diesel and gas engines, etc. Long taper semi-needle type stem-disk for close regulation and tight seating. Fig. 152 series has carbon steel body with EValloy 13% chrome stem-disk. Fig. 2152 series, all 13% chromium stainless steel. Fig. 4152 series, all 18-8 stainless steel.

Screwed Ends—Globe or Angle

Size Range—⅛", ¼", ⅜", ½", ¾" and 1"

Edward INSTRUMENT VALVES 1500 lb sp

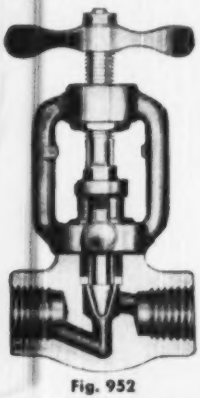


Fig. 952

FIG. 952 SERIES—A compact, heavy-duty valve for instrument panels, regulators, orifice meters, by-pass lines, oil field gage or instrument services, corrosive lines, etc. Drop forged steel body and yoke. No possibility of bonnet joint leakage. Swing bolted gland. Fig. 952 series valves have carbon steel body with EValloy 13% chromium stainless steel trim. Fig. 2952 series has EValloy stainless steel body and trim.

Screwed or Socket Welding Ends—O. S. & Y.—Globe or Angle

Size Range—¼", ⅜", ½"

Edward Globe & Angle Valves 600-1500 lb sp

Fig. 444-944

FIG. 444-944 SERIES—All purpose valves, ideal for nearly any service where O. S. & Y. small forged steel valves are used. Streamlined, low-pressure loss body and bonnet both forged steel. Built with union bonnet in sizes 1" and smaller for 600 lb sp, and in sizes ¾" and smaller for 1500 lb sp. Larger sizes in both pressure classes have bolted bonnet joint. Bronze bushed yoke, simplified bolted gland design for easy packing adjustment, EValpak high pressure-high temperature die-molded packing, and inclined stem design for free flow and minimized turbulence are standard features. Easy to repack, with both hands free to insert packing. Stem, disk and seat hardened EValloy 13% chromium stainless steel regularly furnished; Stellite hard-faced seat and disk available on order.

Fig. 448-948

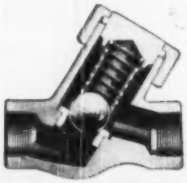
Screwed or Socket Welding Ends—O. S. & Y. —Globe or Angle

Size Range—¼", ⅜", ½", ¾", 1", 1¼", 1½" and 2"

Edward CHECK VALVES 600-1500 lb sp

WIDE CHOICE

Edward forged steel check valves are built in ball or piston types, with union or bolted bonnets, with screwed, socket welding or flanged ends. Available for installation in either horizontal or vertical lines.

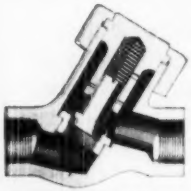


BALL CHECKS

Ideal for viscous fluid service. Spring loaded, fully guided ball disk is stainless steel, as is the mated seat.

Screwed or Socket Welding Ends—Horizontal or Vertical.

Size Range—¼", ⅜", ½", ¾", 1", 1¼", 1½" and 2".

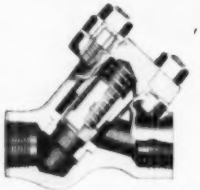


PISTON CHECKS

General service small check valves that give freedom from shock or excessive vibration, yet seat quickly and tightly upon flow reversal.

Screwed, Socket Welding or Flanged Ends—Horizontal or Vertical.

Size Range—¼", ⅜", ½", ¾", 1", 1¼", 1½" and 2".



BOLTED COVER CHECKS

Either ball or piston types, in variations of body style and end connections for boiler feedline or general process services.

Screwed, Socket Welding or Flanged Ends—Horizontal, Vertical or Angle.

Size Range—½", ¾", 1", 1¼", 1½" and 2".

From New Edward Designs

These are among the many new Edward designs. The Edward steel valve line is never static. From a development department devoting its time exclusively to the problems of temperature, pressure and other operating conditions usually associated with the use of steel valves, have come—through the years—literally hundreds of design and material innovations. Many Edward features have become industry standards; others are still exclusive with Edward. The new designs described briefly here are ideally suited for the service conditions of today's power plant, petroleum, industrial and technological installations.

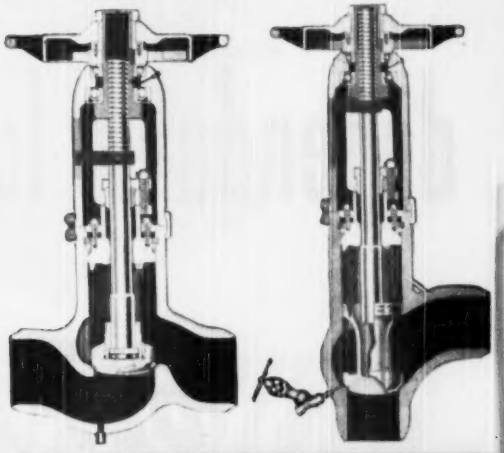
Fig. 2224

Edward
Welded Bonnet
UNIVALVES
1500-2500 lb sp

FIG. 2224 SERIES—Welded bonnet, inclined stem forged steel globe valves. Integral Stellited seat and disk construction, perfect alignment between body and bonnet, contoured for least resistance to flow and to cut wear-producing erosion. Bonnet joint leakage forever eliminated. Forged chromium-molybdenum bodies. Impactor handle available on larger sizes. Fig. 2224 series for 1500 lb service; Fig. 3924 for 2500 lb sp.

Socket Welding Ends—Globe Type

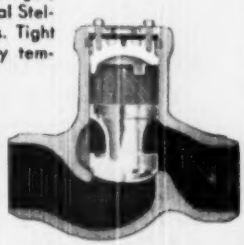
Size Range—½", ¾", 1¼", 1½" and 2"



Cast Steel Pressure-Seal Valves

900-1500-2500 lb sp

GLOBE AND ANGLE STOP, NON-RETURNS, CHECKS—Newest design pressure-seal bonnet valves in globe or angle stop or non-return and horizontal or angle check valves. Many features are Edward "firsts"—Impactor handwheels, EValthrust yoke bushings, Equalizers, streamlined flow passages, etc. Regularly built with integral Stellited seats and Stellited disks. Tight bonnet-joint connection at any temperature, low maintenance, easy disassembly, proven materials for top temperatures and reduced weight are among the features. All types in either 900, 1500 or 2500 lb sp classes.



Size Range—2½, 3", 4", 6", 8", 10", 12" and 14".

Edward
BLOW-OFF
VALVES
300-600
1500 lb sp

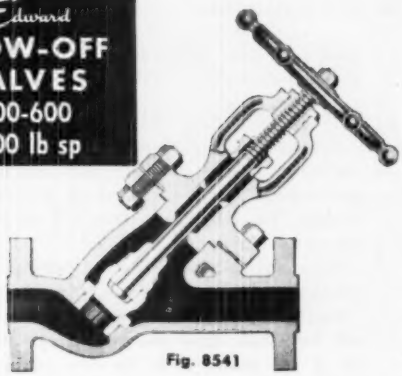


Fig. 8541

FULL RANGE—Edward cast and forged steel blow-off valves, in straightway or angle patterns, meet all standards for blow-off valve service, and give complete flexibility in working piping hook-ups for any space limitation. Slow-opening type so that damaging shock to piping is eliminated.

Flanged or Socket Welding Ends—Straightway or Angle

Size Range—1½", 2" and 2½".

For more data on these or other valves in the complete Edward steel valve line, write for Catalog 104. Or, if you indicate special interests in valves or various types, we can include special bulletins you will find helpful.

Another G Product

Edward Valves, Inc.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

EAST CHICAGO, INDIANA

low-cost process heat

dependable low-speed power

GET BOTH with G-E

If your plant uses process steam, you may be able to improve over-all heat balance by driving low-speed equipment with General Electric geared turbines. Mechanical drive turbines act as reducing valves to drop boiler steam pressures down to utilization temperatures for process requirements. With turbines skimming off only a small portion of the steam's heat, mechanical power for driving fans, blowers, pumps and other low-speed apparatus is almost free.

Standard Type DP and DR turbines, combined with General Electric precision-type gears, are ideal for many such applications.

PRECISION GEARING

General Electric balanced-thrust gears are specifically designed for use with turbine drives. Smoothness and quietness of operation are the result of maintaining tooth contours and spacing to a high degree of accuracy.

Positive lubrication assures long life. Oil is delivered to the bearings from a gear-type pump driven by the pinion shaft. The gear mesh is spray-lubricated.

To meet a variety of application requirements, these gears are available in ratios from 1.5 to 10.3.

PRECISION GOVERNING

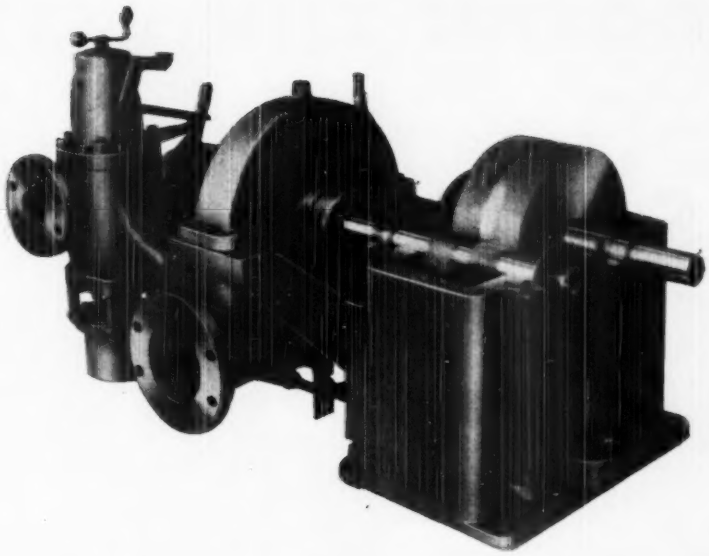
General Electric Type DP and DR turbines include extra features at no extra cost. The DP's hydraulic governing system provides a speed range of 30 per cent with 6 per cent regulation. The DR's oil-relayed governor offers speed ranges up to 5 to 1 with accuracy of ¼ of 1 per cent. Each turbine has its easily operated trip-throttle valve and governing valve combined in one compact unit. Rugged construction from quality materials makes these standard turbines outstanding for reliability and efficiency.

ONE INTEGRAL UNIT

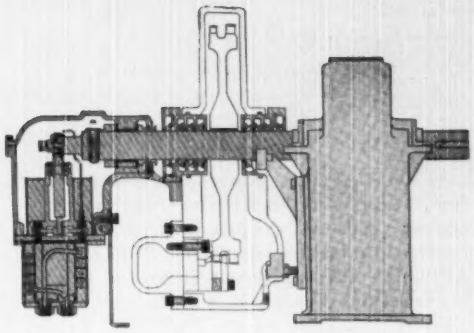
General Electric close-coupled turbine-gear sets have one common turbine and pinion shaft, with the turbine and gear casings solidly connected by a sturdy fabricated bracket. This construction results in a compact unit, does not require high-speed coupling.

Many standard parts are interchangeable with other turbine and turbine-gear drives.

Your nearby General Electric sales office will supply you with full details about mechanical-drive turbine-gear sets. Or, if you prefer, write for free copies of illustrated bulletins on these drives. The DP and DR turbines are described in bulletins GEA-4955 and GEA-5193. Bulletin GEA-5152 contains information about gears. Learn how installing these precision drives in your plant can save you money. Apparatus Department, General Electric Company, Schenectady 5, N. Y.



TURBINE-GEAR DRIVES



HERE'S WHAT STANDARDIZATION PROVIDES FOR YOU

This diagram shows how a standard DP turbine is close-coupled to a low-speed gear using an integral turbine and pinion shaft. All shaded turbine parts are interchangeable on all sizes of DP turbines. Thus, it is easy to stock spares, and maintenance costs are reduced. All individual turbine models and gear sets have standard shaft heights for easy installation or re-location in your plant. In addition, standardization cuts manufacturing expense, and the savings are passed on to you in the form of extra features usually found only on "special" turbine-gear drives.

GENERAL ELECTRIC

252-49

AT SUN'S NEWEST REFINERY..

Sun Oil Company's new cat cracker at Toledo, Ohio

Reaching twice as high as the Statue of Liberty, this 308-foot Houdriflow unit forms the heart of Sun's newest refinery. It can produce 600,000 gallons of New Blue Sunoco gasoline daily, plus other products, doubling the capacity of the Toledo plant.

OIC Valves are at work in many strategic points throughout this refinery. They give efficient, precise control because they're—

PRECISION ENGINEERED—positive closure ... minimum friction... designed for smooth, free flow. PRECISION BUILT—every essential part accurately finished for a precise fit, on the most modern production equipment. PRECISION APPLIED—OIC engineers will assist in selecting valves to suit each job, at lowest cost.

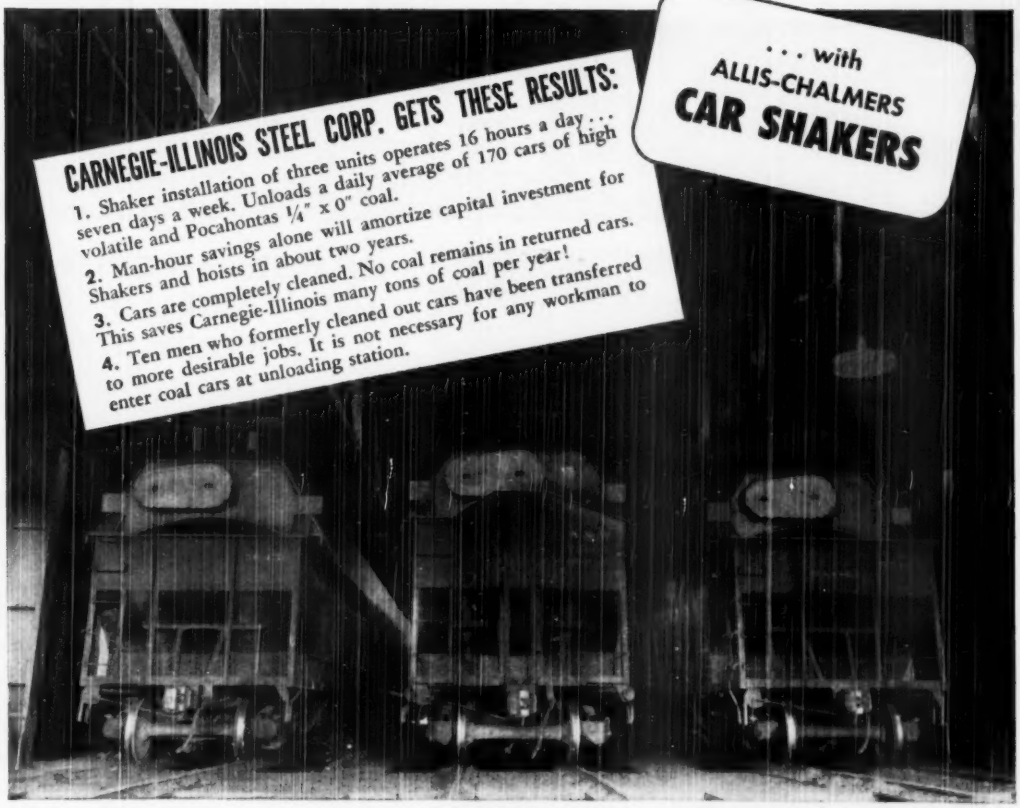
For a free copy of the 1950 OIC Valve Cross-Reference Chart, see your local distributor or write us direct. The Ohio Injector Company, Wadsworth, Ohio.

OIC
FOUNDED 1883

VALVES

FORGED AND CAST STEEL · IRON · BRONZE

STEEL MILL UNLOADS
170 Coal Cars Daily!


CARNEGIE-ILLINOIS STEEL CORP. GETS THESE RESULTS:
1. Shaker installation of three units operates 16 hours a day . . . seven days a week. Unloads a daily average of 170 cars of high volatile and Pocahontas ¼" x 0" coal.
2. Man-hour savings alone will amortize capital investment for Shakers and hoists in about two years.
3. Cars are completely cleaned. No coal remains in returned cars. This saves Carnegie-Illinois many tons of coal per year!
4. Ten men who formerly cleaned out cars have been transferred to more desirable jobs. It is not necessary for any workman to enter coal cars at unloading station.
. . . with
ALLIS-CHALMERS
CAR SHAKERS

YOU CAN GET SIMILAR SAVINGS in demurrage charges and man-hours by installing an Allis-Chalmers Car Shaker. And you save with safety! Accidents are eliminated as workmen do not have to mount the car during the automatic unloading operation.

The Shaker is driven by a 15 hp, high torque, integrally enclosed Allis-Chalmers motor — mounted on rubber to protect motor from severe vibration.

For complete information on how the Car Shaker can help *you* save time and money, contact your nearby A-C Sales Office. Or write for Bulletin 07B7221.

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

Please send Car Shaker Bulletin 07B7221.

Name

Title

Firm

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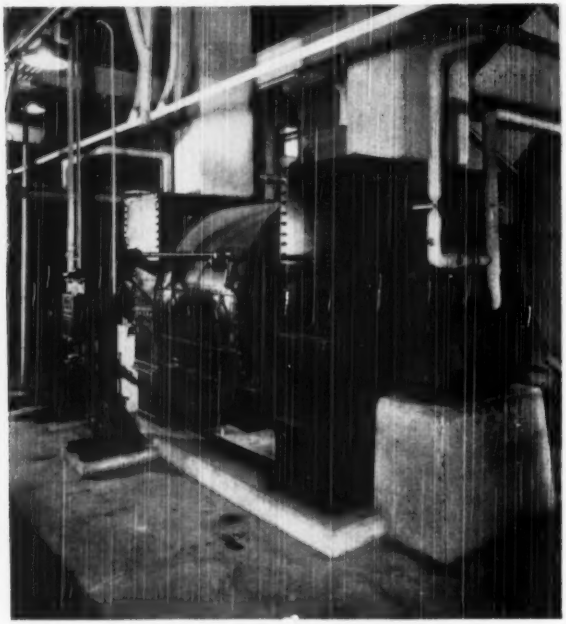
ALLIS-CHALMERS

KEY INDUSTRIES DEPEND ON "Buffalo" FANS



WHERE RUGGEDNESS MEANS ECONOMY!

Above photo of "Buffalo" Induced Draft Fan in Interstate Power Company's Lansing station, Lansing, Iowa, shows rugged construction. Induced draft is one of the severest services to which a fan can be subject. It's ALWAYS an economical policy to specify "Buffalo" Fans, because they *last* on the job!

INTERSTATE POWER CO. USES "BUFFALO" FANS FOR EFFICIENT COMBUSTION

Power generation, key industry in industrial America, must be efficient!

This is why well-run power companies like *Interstate* have chosen "Buffalo" Draft Fans. They are heavily built where wear occurs, which means longer operating periods without replacements. They are built with all parts accessible for quick servicing and minimum down-time. High efficiencies mean driving economy, and pressure characteristics are stable over a wide range of capacities. "Buffalo" Induced Draft Fans are designed for best efficiency with high static pressure and comparatively low velocity through rotor, housing and fan cutoff, greatly reducing erosion. "Buffalo" Forced Draft Fans deliver rated air capacity even if fuel bed load is unusually heavy. *WRITE FOR BULLETIN 3750, shown, for complete facts.*

FIRST FOR FANS

"Buffalo"

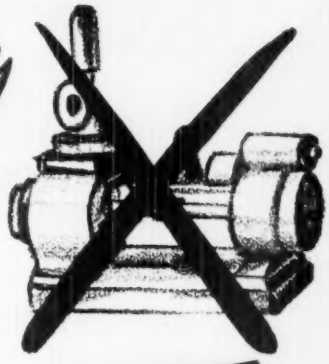
BUFFALO FORGE COMPANY

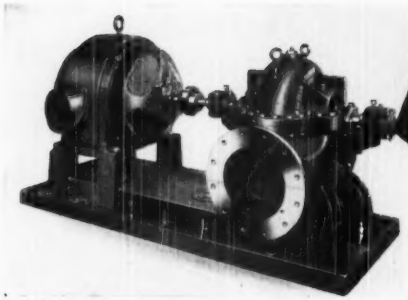
488 BROADWAY BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont., Branch Offices in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT PRESSURE BLOWING | EXHAUSTING

Yesterday's Pumps Doing Today's Job?

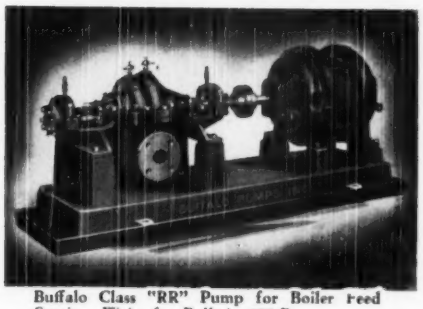




REPLACE with "Buffalo" PUMPS

- YOU'LL SAVE IN MAINTENANCE
- YOU'LL SAVE IN POWER CONSUMPTION
- YOU'LL REDUCE PROCESS TIMEOUTS

Buffalo Type "SL" Pump for Clear Water Service, 10 to 10,000 gpm Capacities. Write for Bulletin 955-N.



Buffalo Class "RR" Pump for Boiler Feed Service. Write for Bulletin 980-B.

YES—if you are doing a present-day capacity job in your plant, but doing it on pumps that have long been obsolete—it's a money-saving proposition to replace with modern "Buffalo" Pumps!

You'll find that, where those old pumps were continually on the "repair list", and were hogging power, your "Buffalo" Pumps will use little power for the work done—and require practically no attention over many years.

And there's a "Buffalo" Pump for best work on every special job—clear water or chemical. WRITE US YOUR PROBLEM—for the best replacement you can make.

"Buffalo" PUMPS

BUFFALO PUMPS INC.

488 BROADWAY BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.

Branch Offices in All Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Still another condenser starts off right!

CHASE ANTIMONIAL ADMIRALTY

(a patented alloy)

It is off to the right start with Chase Antimonial Admiralty* Condenser Tubes—the tubes with the right amount of the right inhibitor.

And these tubes will *stay right*—give years of trouble-free service—because the antimony resists dezincification so effectively. Important, too, is the fact that antimony will not affect the metal's grain structure. With antimony, the tube stays tough, hard, serviceable—for years.

After years of study and research, it is our firm opinion that antimony is the best inhibitor for Brass condenser tubes. Investigate Chase Antimonial Admiralty before *you* replace condenser tubes—they cost no more than plain Admiralty.

*U. S. Pat. No. 2,061,921

Special stocks of ANTIMONIAL ADMIRALTY Condenser Tubes in Chase Warehouses: NEW YORK, BALTIMORE, NEW ORLEANS LOS ANGELES, SAN FRANCISCO

also carried by— Vinson Supply Co., Tulsa; Standard Brass & Mfg. Co., Houston

Chase

the Nation's Headquarters for BRASS & COPPER

WATERBURY 20 CONNECTICUT

SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DALLAS DENVER† DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† ST. LOUIS SAN FRANCISCO SEATTLE WATERBURY †Sales Office Only

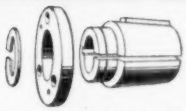
4 BIG ADVANTAGES!

ONE PIECE MOUNTING

Bushing and sheave go on together. One motion mounting. Alignment is easier. Sheave is on right first time.

POSITIVE DRIVE

Bushing is keyed to both shaft and sheave. No slipping. No sheared screws. No jammed bushings from bent screws.



FULL CIRCLE GRIP

Bushing split full length with separate collar. Grips shaft full length around full diameter. No forcing or distortion. Grip easily broken. No hammering.

WIDE SIZE RANGE

Magic Grip sheaves are available from 3" pitch diameter up. Style NC bushing for smaller sizes and Style C bushing for larger sizes.

MAGIC GRIP SHEAVE

YOU CAN MOUNT a *Magic Grip* sheave faster than any other sheave you can buy . . . and demount it just as fast. When you mount a *Magic Grip* sheave it runs true. It will not slip or jam. It always comes off easily.

Even if you don't change sheaves often, you should have *Magic Grip* sheaves on every drive to eliminate the possibility of shaft and bearing damage when ordinary sheaves are hammered or pried on or off.

WIDEST V-BELT LINE

Get everything you need for your V-belt drives from one reliable source. *Texrope* offers the broadest line of V-belts, standard and variable speed sheaves and speed changers in the industry. And you also get the extra engineering skill that comes from having more industrial V-belt installations than any other manufacturer.

Get your copy of the 144 page *Texrope* Pre-Engineered Drive Manual from your A-C Authorized Dealer or Sales Office or write for Bulletin 20B6956.

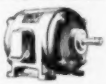
A-3022

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

Texrope and *Magic Grip* are Allis-Chalmers trademarks.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

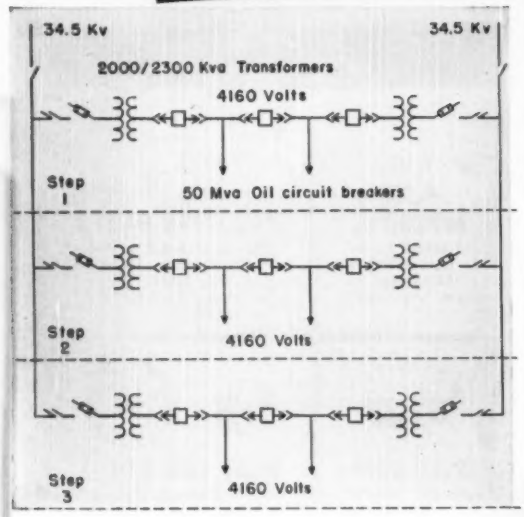
PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

A-C

ALLIS-CHALMERS

UNIT SUBSTATION

LAYOUT WITH G-E SUBSTATIONS



STEP 1	GE Duplex Unit Substation and structure (including landscaping)	$57,000
	Installation	15,000
STEP 2	GE Duplex Unit Substation and structure plus installation	62,000
STEP 3	(Same as Step 2)	62,000
	Total cost	$196,000

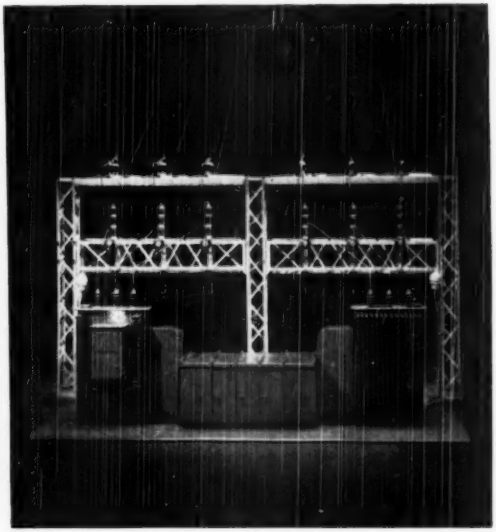
Note how the one-line diagram at the left, using General Electric Duplex Unit Substations, duplicates in every respect the electrical functions of the proposed piecemeal arrangement—at a savings of $84,000, or 30%. Individual feeder voltage regulation is economically obtained by load-ratio-control transformers, since each transformer normally serves only one feeder. The compact construction of the G-E substation made landscaping easy—and inexpensive.

General Electric Unit Substations give further savings by deferring investment costs and by allowing expansion to take place logically and when needed, and without the obsolescence of breakers. Also, the small units allow the use of breakers of relatively low interrupting rating.

When you order General Electric Unit Substations your engineering involves only a simple one-line diagram like the one above. We do all the detailed specs, prepare construction drawings, electrical diagrams, operating instructions and other paper work to give complete co-ordination of the project—all this on one purchase order, and at lower costs than piecemeal, field-assembled types.

For further information ask your G-E Sales Representative for the publications listed or write to *Apparatus Department, General Electric Company, Schenectady 5, N.Y.*

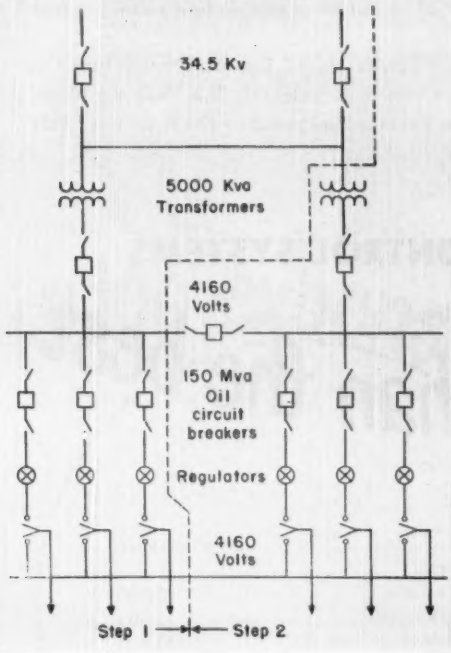
Master Unit Substations	GEA-3800
Single-circuit Unit Substations	GEA-4300
Package Substations	GEA-4500
Rural Package Substations	GEA-5276



Here's a view of a G-E Duplex Unit Substation similar to the ones in the layout above.

LAYOUT SAVES 30%

PROPOSED PIECEMEAL ARRANGEMENT



STEP 1	Three feeders and proportionate cost of brick building*	$180,000
STEP 2	Three feeders and remaining cost of brick building	100,000
	Total cost	$280,000

*Transformers and 34.5 kv breakers to be located outside behind ornamental brick building housing remainder of switchgear, regulators, etc.

This proposed piecemeal arrangement is of the spot network type. It is based on a typical installation using 1950 cost figures. Accurate feeder voltage control can be provided by separate voltage regulators on each feeder in conjunction with a regulator transfer bus.

To see how the G-E Duplex Unit Substation layout did the same job—at a savings of $84,000, or 30%—over the above arrangement, look at the layout on the opposite page.

GENERAL ELECTRIC
321-69

In any typical power plant installation, the *difference in cost* between the best possible combustion control system and a "second best" system is less than the cost of the fuel burned in one week.

The *difference in performance*, though it may be as little as ½ of 1% of fuel consumption, means a fuel saving *every year of operation* of two to four times as much as the difference in cost.

Here is how it works out in three typical power plants, assuming 6,000 hours of operation per year and a life of 20 years—which is considerably less than the useful life of the average boiler, and using current average fuel prices—which are not likely to decrease within the foreseeable future.

IN COMBUSTION CONTROL SYSTEMS

anything less than the best

Plant Cost	$1,600,000
Boiler Capacity—100,000 lb/hr steam	
Estimated cost of simplified control system	20,000
Estimated cost of best possible control system	25,000
Fuel cost over a 20-year period, minimum	4,800,000
Fuel cost over a 20-year period, maximum—not less than	6,000,000

Saving on fuel by using best possible control, estimated at ½ of 1%—from $24,000 to $30,000.

CASE No. 1

The thousands of Hagan Combustion Control Systems, installed in plants of all types and sizes, in all parts of the country, are your assurance that Hagan Control in your plant means maximum efficiency with the minimum maintenance throughout the whole life of the boiler. Our engineers will be glad to provide full information. Hagan Corporation, Hagan Building, Pittsburgh 30, Pennsylvania.

CASE No. 2

Plant Cost	$ 8,250,000
Boiler Capacity—500,000 lb/hr steam	
Estimated cost of simplified control system	40,000
Estimated cost of best possible control system	55,000
Fuel cost over a 20-year period, minimum	24,000,000
Fuel cost over a 20-year period, maximum—not less than	30,000,000

Saving on fuel by using best possible control, estimated at 1/2 of 1%—from $120,000 to $150,000.

is too expensive.

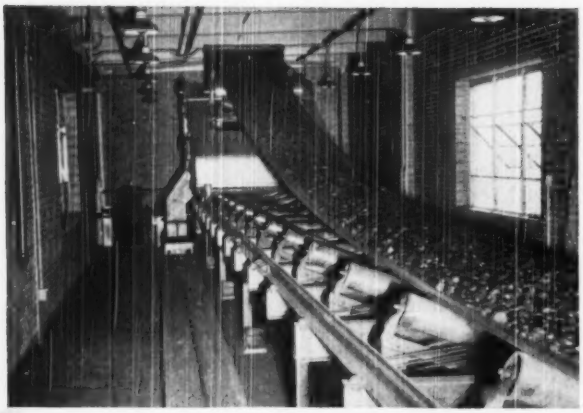
CASE No. 3

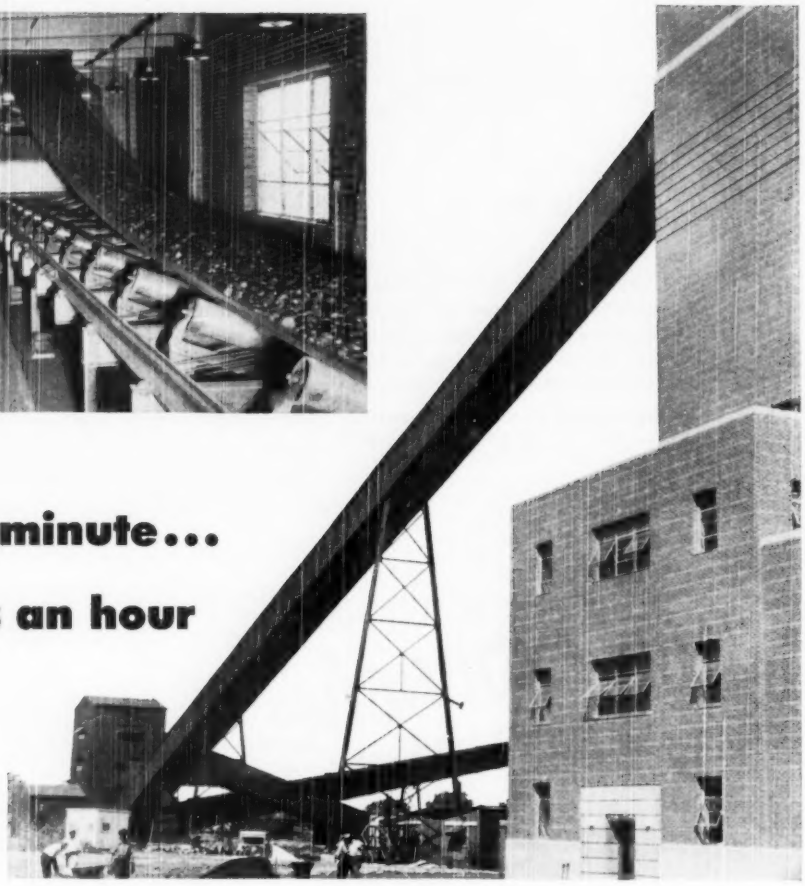
Plant Cost	$ 42,000,000
Boiler Capacity—2,500,000 lb/hr steam	
Estimated cost of simplified control system	45,000
Estimated cost of best possible control system	75,000
Fuel cost over a 20-year period, minimum	120,000,000
Fuel cost over a 20-year period, maximum—not less than	150,000,000

Saving on fuel by using best possible control, estimated at 1/2 of 1%—from $600,000 to $750,000.

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES





6 tons a minute...

or 6 tons an hour

S-A Conveyor Systems Permit Either at LOWEST COST PER TON HANDLED

Whether you need a high capacity belt conveyor system as shown above or a simple REDLER conveyor-elevator for handling a few tons per hour, S-A engineers can help you find the right method and the right equipment to give the most efficient and economical service over the life of the equipment.

360 tons of coal per hour at the plant shown is the handling and storage job that the S-A belt conveyor system takes in stride at the push of a button. Fast, efficient, completely mechanized conveyor layouts such as this mean lowest handling costs per ton for any power plant . . . large or small.

Write us about *your* handling problems . . . there is no obligation.

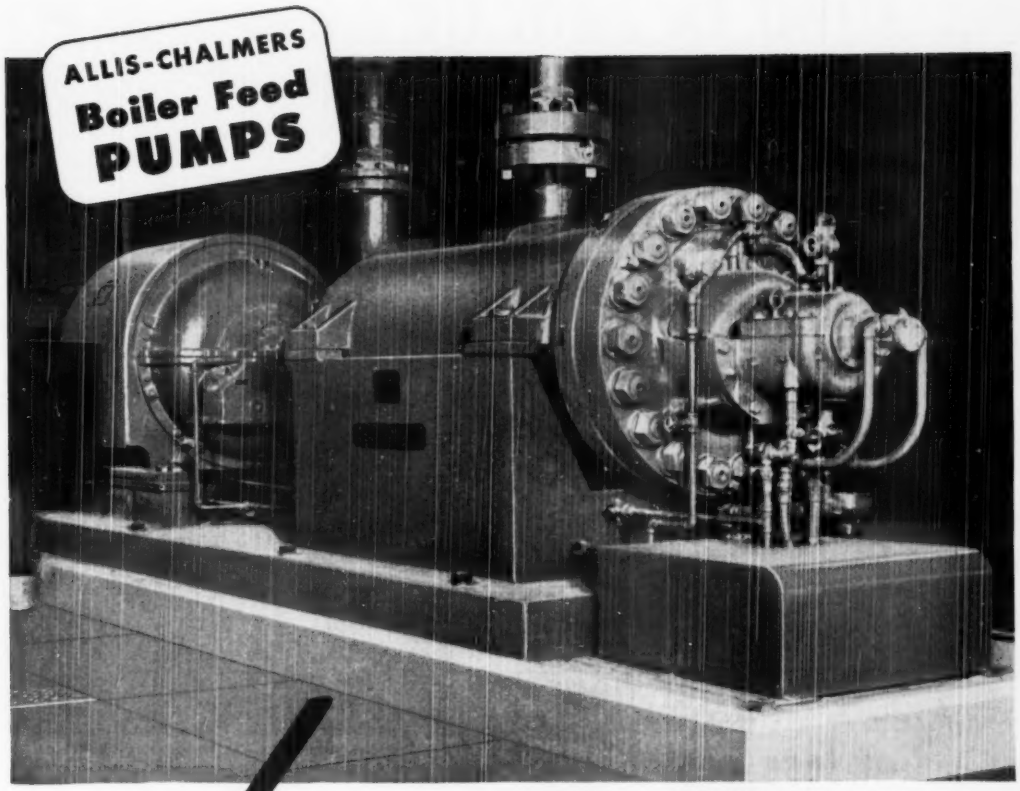
CORN PRODUCTS REFINING COMPANY, ARGO, ILLINOIS

Coal dumped from rail cars into double track hoppers is fed over two reciprocating plate feeders to a 200-foot long belt conveyor to crusher house. Crushed coal may be moved direct to boiler house or diverted to outdoor storage by two additional S-A belt conveyors. Coal reclaimed from storage re-enters belt conveyor system to boiler house through auxiliary hopper. Traveling tripper discharges coal from belt conveyor over boiler house bunker through slots on each side of the conveyor formed by two-piece rubber belts covering the bunker. Zipper teeth open and close around the tripper spouts to form effective bunker seals which keep coal dust inside the bunker.

STEPHEN S-A DAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif. • Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT



Install New Boiler Feed Pump

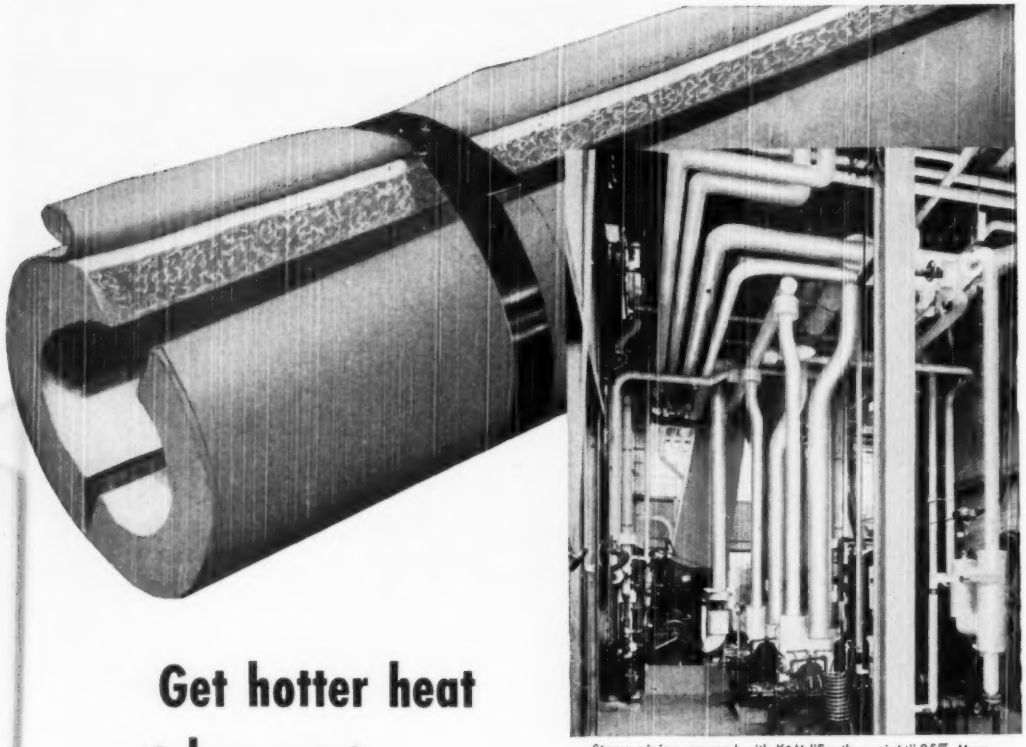
HERE IS ONE OF THREE Allis-Chalmers barrel-type boiler feed pumps installed in one of the East's newest and most modern power plants. Pump is 5" x 5", 12 stage unit with capacity of 227,000 lbs/hr (480 gpm) against 1750 psig head. The motor is an Allis-Chalmers 800 hp 2-pole machine.

This pump was designed especially for the higher pressure ranges becoming more common in the newer plants. The internal split casing joint is held in compression by the full hydraulic pressure of the system assuring a leak-proof joint. Impellers are of single suction, back-to-back design assuring axial balance. Volute casing maintains radial balance. Expansion, especially for quick changes in temperatures, between the inner and outer case is taken care of without the use of an internal flexible gasket member. The Allis-Chalmers pump brings this joint to the outside. Maintenance is easier. Leakage is immediately obvious so adjustment can be made before damage to the pump occurs.

For more information on the new Allis-Chalmers barrel-type boiler feed pump, call your nearest A-C Sales Office or write directly to the factory. A-3209

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS



Steam piping, covered with K&M "Featherweight" 85% Magnesia, in Standard and 1½" thicknesses; canvas covered.

Get hotter heat at less cost with K&M "FEATHERWEIGHT"® insulation

Keep heating costs down—and heating efficiency up—with K&M "Featherweight" 85% Magnesia Insulation. 85% Magnesia is the most widely accepted insulating material in its field. And in K&M "Featherweight," basic carbonate of magnesia is combined with selected and specially processed asbestos fibers to produce a highly efficient insulation of extremely low thermal conductivity.

K&M "Featherweight" withstands temperatures up to 600° F. without loss of insulating value. And, though it's amazingly light in weight, it is strong and durable also. It can withstand vibration, a reasonable amount of compression, and its insulating properties are not affected by alternate wetting and drying. As it is entirely mineral by nature, it cannot burn.

"Featherweight" 85% Magnesia insulation is easy—and economical—to apply. It can be stored and handled without any special precautions. No special tools are needed to apply it: "Featherweight" is easily sawed and cut; can be fitted snugly to contours without breaking apart.

K&M "Featherweight" 85% Magnesia is furnished for all standard pipe sizes in sections and in sets of segments 3 feet long in the following thicknesses: Standard, 1½", 2", double standard (broken joint) and 3" (broken joint). Blocks and lagging are also available for irregular surfaces. Ask your K&M Distributor for complete information, or write us direct.

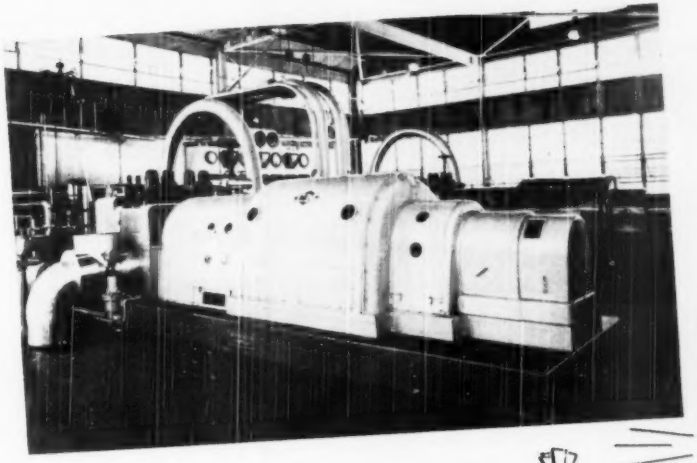
K&M best in asbestos®

Nature made Asbestos . . . Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

In Canada: ATLAS ASBESTOS CO., LTD. • MONTREAL • TORONTO • WINNIPEG • VANCOUVER

HANDLING TWO JOBS AT ONCE...



and saving money on both!

Two 1500 KW Worthington turbine-generators, installed in the Eunice, N. M. plant of the El Paso Natural Gas Company. These are non-condensing extraction turbines designed to operate on initial steam conditions of 575# — 575° FTT exhausting at 5#G back pressure.

Worthington Turbine-Generators Selected By Natural Gas Firm For Both Power and Product-Conditioning

Pumping natural gas from southeastern New Mexico and the Texas Panhandle to points in California and Arizona, the El Paso Natural Gas Company uses Worthington Turbine-Generators for double duty. Besides furnishing electricity for the company's plant in Eunice, N. M., the turbines automatically extract steam at 125#G for heating Amine solution, which is mixed with the gas to remove impurities.

In every branch of industry, users are getting daily proof of the outstanding flexibility of Worthington Turbine-Generator Sets — not only as sources of more dependable, more economical electric power, but as cost-cutting suppliers of processing steam for many important allied purposes.

WORTHINGTON TAKES ALL THE RESPONSIBILITY

Worthington builds Turbine-Generator Sets in sizes up to 10,000 kw, and in all types. Each is designed to make steam do more work, and each is backed by Worthington's undivided responsibility for the complete unit's design, assembly and performance. For expert aid in selecting the *right* size and type for your own requirements . . . and further proof that *there's more worth in Worthington* . . call our nearest District Office. Or write to *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, N. Y.*

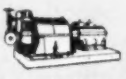
WORTHINGTON

STEAM TURBINES

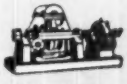
T-O-8

A GREAT TEAM IN STEAM

Feed Water Heaters



Multi-Stage Turbines



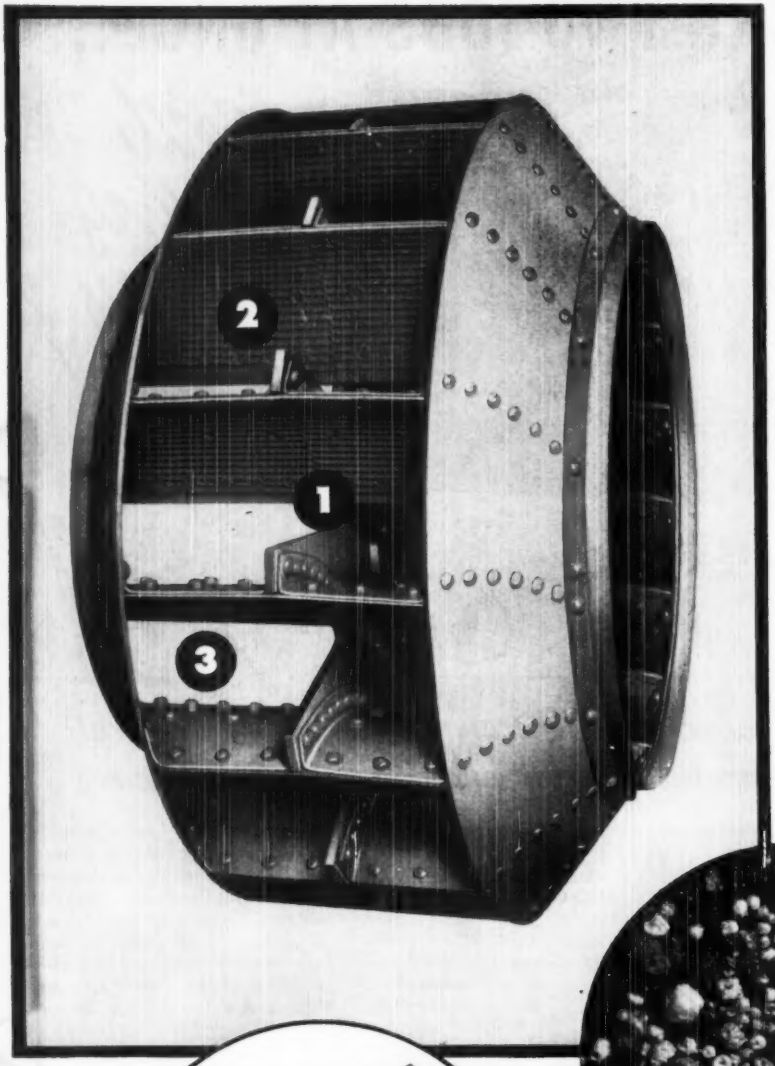
Boiler Feed Pumps

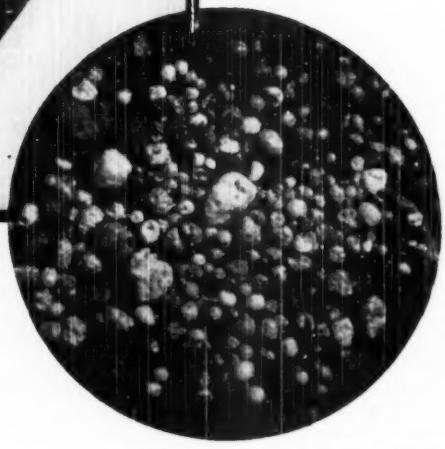
Turbine-Generator Sets

Single-Stage Turbines

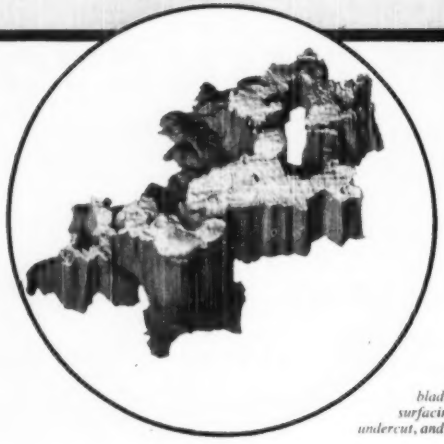
Surface Condensers

NO





Photomicrograph shows typical fly-ash resulting from the burning of pulverized fuel in a modern power plant. Fly-ash produced by stoker coal is similar in appearance.



Here's what fly-ash can do to a fan blade protected against erosion by hard-surfacing. Note how the surfacing has been undercut, and the metal of the blade itself attacked.

OTHER INDUCED DRAFT FAN

MATCHES THE PERFORMANCE OF THE

Sturtevant E-R WHEEL

Present-day high capacity ratings that increase fan-wheel abrasion by fly-ash also result in costly replacement, maintenance and down-time. But low maintenance and a minimum of time lost are possible with the Sturtevant Erosion Resistant Wheel. The proven, exclusive Sturtevant design causes the streams of fly-ash to attack each other, not the wheel surfaces, because the center plate is cut away (1) between the blades.

Special ribbed liners (2) armor the E-R Wheel against the abrasion of fly-ash. They can be easily and economically replaced on the job.

Fewer blades and the absence of tie-rods (3) mean less obstruction to the flow of fly-ash and less surface wear from eroding action.

The Sturtevant E-R Wheel is the soundest investment you can make when considering induced draft equipment. You get this efficient wheel in Sturtevant Turbovane® Induced Draft Fans. It is possible that your present fan installation can be modernized with E-R Wheels. For full details contact your nearest Sturtevant Office, or write Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

YOU CAN BE SURE... IF IT'S

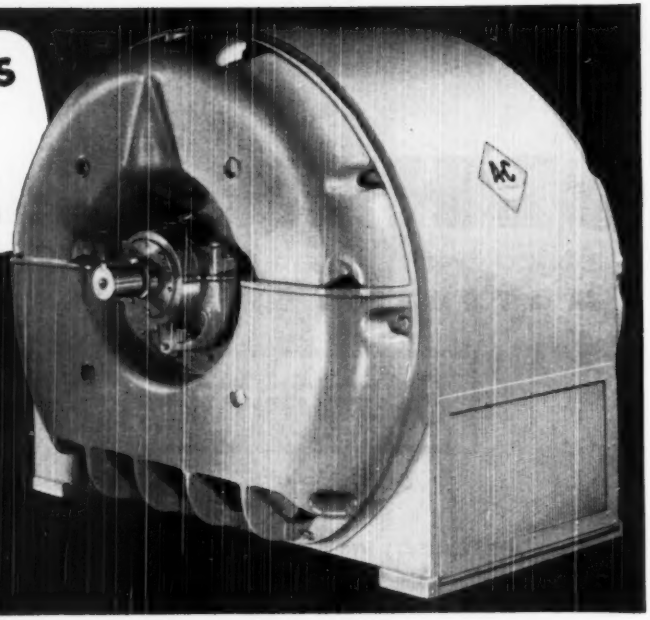
Westinghouse

J-80205A

ALLIS-CHALMERS

LARGE MOTORS

NEW



Built to Cut Maintenance

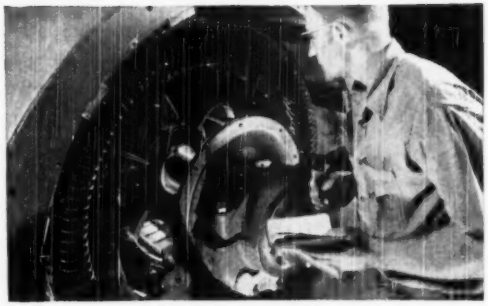
EASIER MAINTENANCE PROCEDURES and lower maintenance costs are important features of this brand new line of large motors. One man can perform all routine maintenance procedures, including opening up the motor for cleaning. Bearing surfaces are not exposed to abrasive grit and dirt during cleaning operations.

The appearance of this new line of large motors reflects the advanced design and fine workmanship that goes into their manufacture.

A well-braced, sturdy fabricated steel frame with cast-iron end brackets rigidly support and protect working parts. Ventilating openings are large to provide adequate cooling air at low velocities with resultant low sound level.

Wide Range of Sizes

These new design Allis-Chalmers drip-proof and splash-proof squirrel-cage induction motors are built in sizes from 60 hp at 300 rpm to 1500 hp at 1800 rpm. Ask your Allis-Chalmers representative to show you the details of this exceptional new motor or write for Bulletin 05R7542.



How's This for Accessibility

One man can remove the end brackets and air baffles and reach right inside motor with his vacuum cleaner or air hose. Bearing remains sealed against abrasive dirt throughout the cleaning operation.

Large air discharge openings with removable louvers allow plenty of room to get in with an electric drill for doweling and bolting the motor to the base. Plenty of room to reach up back of the stator core for cleaning.

A-3179

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

ALLIS-CHALMERS

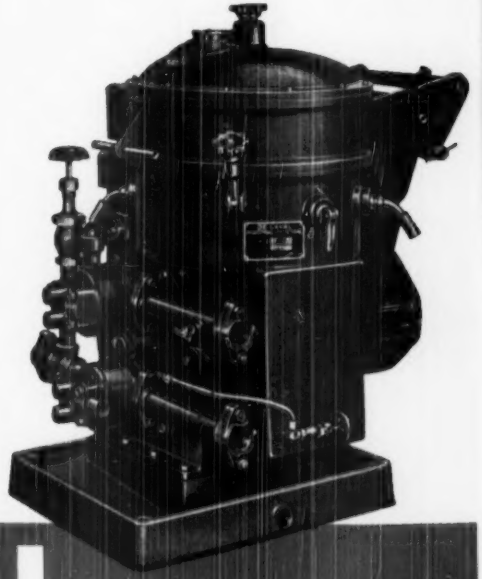
A-C ALLIS-CHALMERS

I STOP TROUBLE before it STARTS!

"I am De Laval Centrifugal Force. I am expert at removing dirt and water from lubricating oil — either turbine lube or Diesel lube. And because dirt and water are the chief causes of lubricating oil deterioration, I actually guard your power plant against trouble. I stop trouble where it counts — ***before*** it happens."

De Laval Centrifugal Force does its job thoroughly. The water is continuously discharged after being removed from the oil by centrifugal force, and the dirt is stored in the bowl, outside the zone where purification takes place.

De Laval Oil Purifiers offer still another advantage to plant operators — these machines have enough reserve capacity to take care of a sudden emergency, such as a surge of water due to a leak.



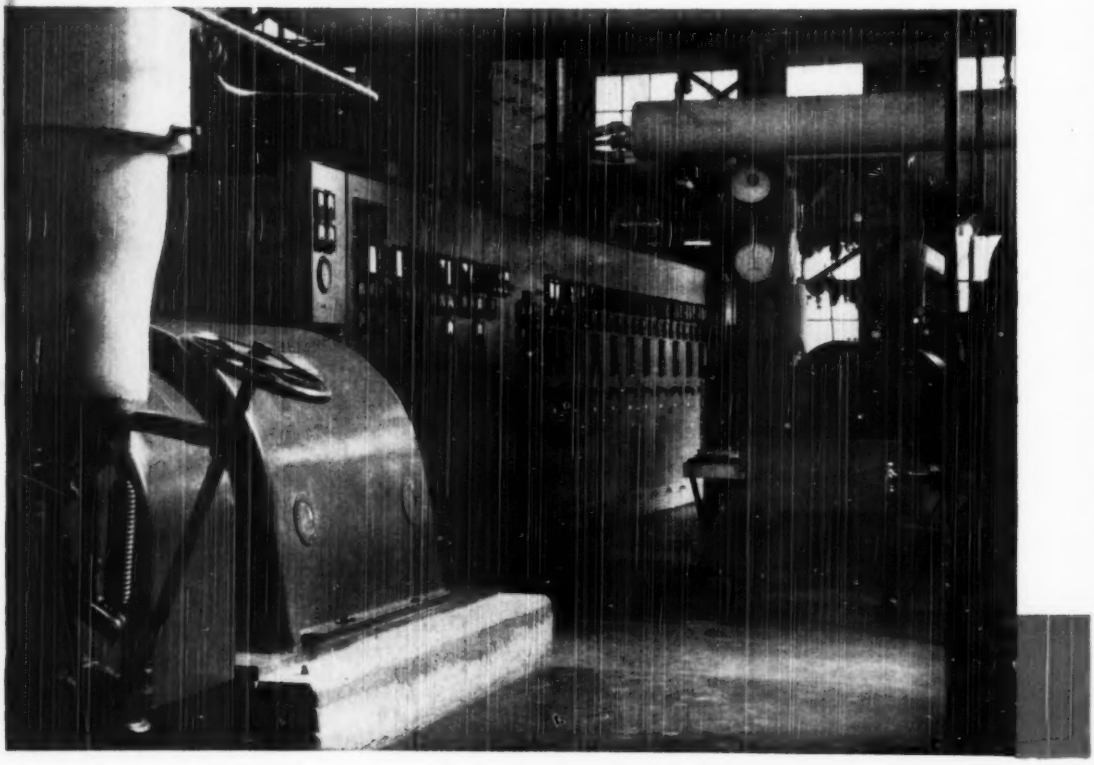
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

De Laval OIL PURIFIERS

FREEPORT SULPHUR EXPANDS

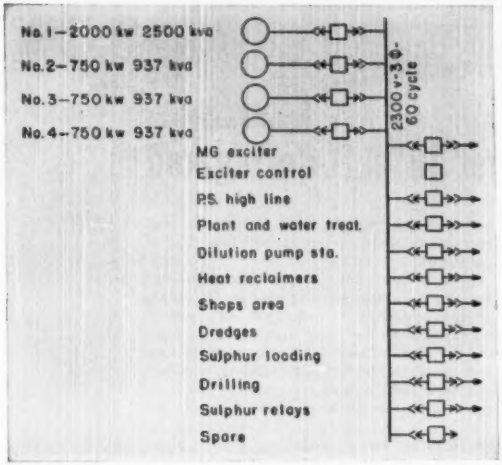
This inadequate, open-type switchgear was replaced by the new G-E Metal-clad equipment shown below. Freeport Sulphur officials recognized that the old switchgear had outgrown its usefulness.

Here's the new General Electric 5-kv Metal-clad switchgear installed at Freeport Sulphur. Magne-blast power circuit breakers have plenty of "IC" (Interrupting Capacity) to handle all short circuits that may occur on Freeport's expanded distribution system. This assures continuous power for vital production.



AND MODERNIZES WITH

METAL CLAD SWITCHGEAR



This one-line diagram shows power distribution at Freeport Sulphur as planned by Sargent and Lundy, consulting engineers of Chicago. General Electric Metal-clad switchgear handles the 2300-volt power from the generators through power circuit breakers of 100,000-kva interrupting rating.

The Freeport installation is a complete General Electric project—one source of responsibility plus the very best in co-ordinated planning, engineering, manufacturing, and service facilities to give maximum savings and efficiency to the customer.

Be sure to see the "More Power to America" full-color sound slide-film "Modern Industrial Power Distribution." Ask your G-E sales representative to arrange a showing for your organization.

WHEN Freeport Sulphur expanded their production facilities they put in a new turbine to take care of the increased load.

At the same time they replaced all their old equipment with General Electric switchgear.

When you order G-E switchgear you get all the equipment and service from one reliable source. And with everything pre-assembled at the factory it takes very little time to get the switchgear in place and operating.

MODERN INDUSTRIAL power distribution systems using G-E switchgear are applicable to any industrial plant or commercial building where you want. . . .

- Proper voltage for top performance of equipment
- An extremely flexible setup to take care of expanding or changing loads
- Adequate short-circuit protection
- Protection for personnel
- Low installation and maintenance costs

INVESTIGATE TODAY the many advantages of using General Electric switchgear to get the same benefits gained by Freeport Sulphur. Contact your G-E sales representative for further information—or write for the helpful bulletins listed below. *Apparatus Department, General Electric Company, Schenectady 5, New York.*

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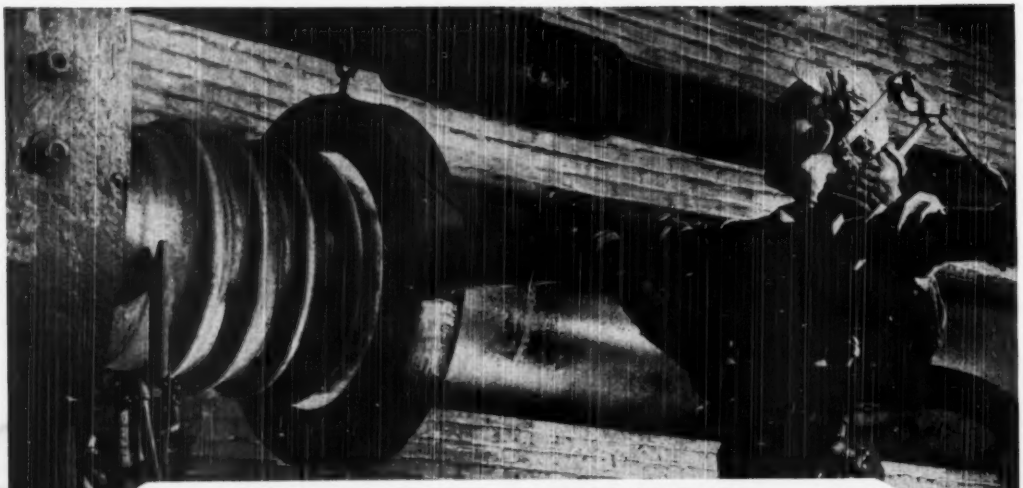
GEA-4966 Low-voltage Metal-enclosed Switchgear
GEA-3592 Load-center Unit Substations
GEA-3758 Load-center Power Distribution

GENERAL ELECTRIC



Special Machine makes first 30" O.D. Corrugated Alloy Piping . . .

The first 30-inch O.D. chrome-moly corrugated piping was recently formed on the unique device shown here. Totaling some 90 feet over-all, eight pieces comprise the complete order. They are for the major part of the exhaust-steam line from a topping turbine in a main power station of a metropolitan utility in the East.

Beyond physical size itself, the major problem in fabrication was to preclude cracking, a defect much more apt to occur in forming chrome-moly than in working either carbon or carbon-moly steels. Through carefully controlled incremental heating and subsequent compression on a specially built machine, the corrugations were formed, giving the final corrugated piping five times the flexibility of plain piping.

Specific know-how in incremental heating was to a large degree responsible for the success of this operation . . . this and an extensive background in the fabrication of alloys. Over the years special alloy fabricating methods have been developed by Kellogg engineers, who have been entrusted with such recent innovations in power piping at the first HT-HP stainless steel installation and the fabrication of piping for the original 1050°F. station.

Knowledge of such special techniques is among the advantages utility companies gain when they specify M. W. Kellogg HT-HP power piping.

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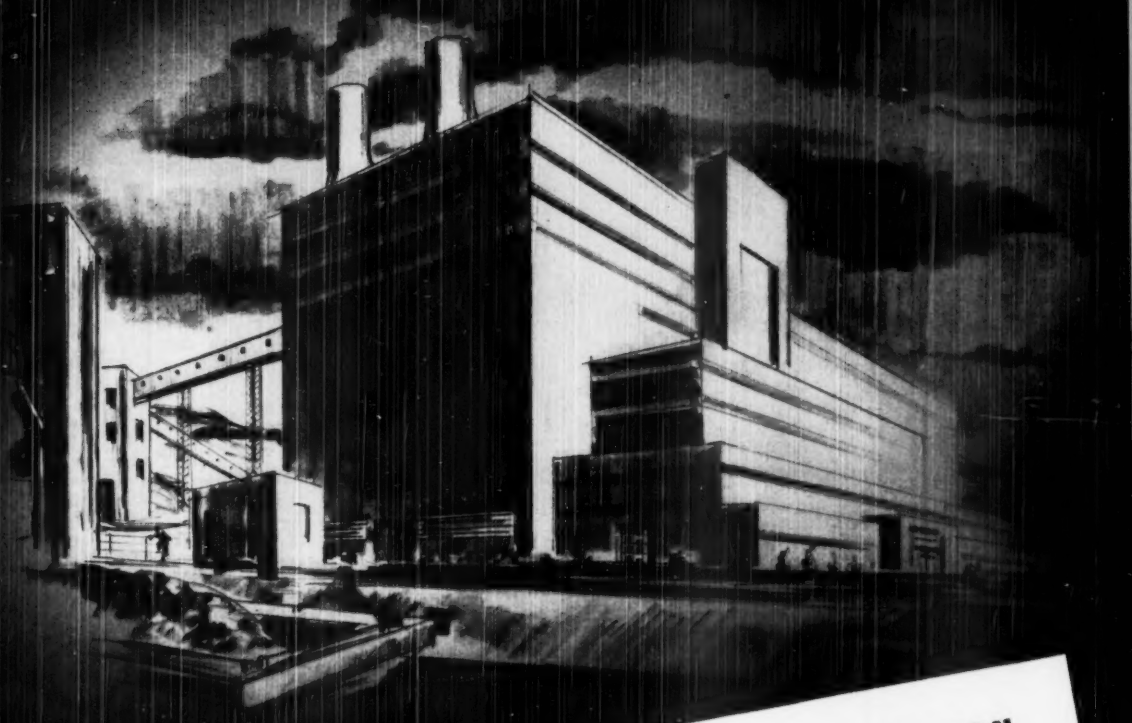

DUQUESNE LIGHT COMPANY'S new Elrama power plant, near Pittsburgh, now under construction by Dravo, will increase Duquesne's system capacity by almost 25%. Dravo will serve as construction agent for the entire project, including a coal unloading dock, a mechanized coal-handling system, outdoor switching facilities and a screen house. This is the third large-scale power project entrusted to Dravo by Duquesne Light within the past two years.

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POWER

NOVEMBER 1950 · VOL 94 · NO. 11

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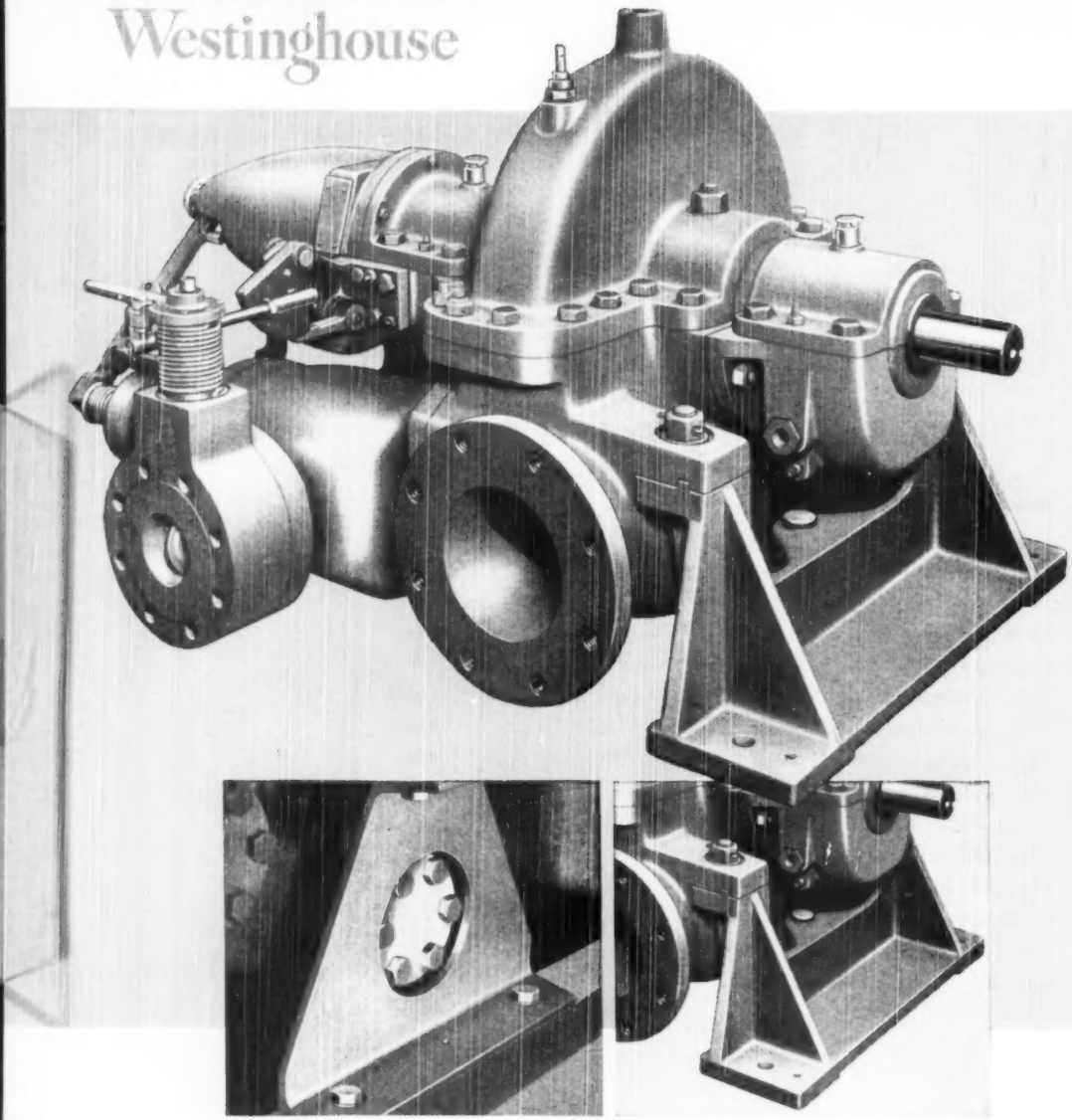
Westinghouse



Centerline support at governor end

Centerline support at exhaust end, including vertical kingpin

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The Type E method of support allows three-way freedom of expansion and contraction without disturbing the alignment of the rotor shaft. The governor end is mounted on a strong but flexible channel beam to permit axial expansion. At the shaft-coupling end, a unique keyed support connects to the turbine near the shaft centerline to permit lateral expansion; and a vertical kingpin transmits thrust from the expanding steam pipes directly to the foundation and not to the turbine. Thus, the casing is left free to move vertically with expansion or contraction.

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Heat expansion can't disturb Type E alignment. The operation of driven equipment is easier, more dependable—installation costs are reduced. Westinghouse unique *three-way centerline support* keeps alignment perfect with the driven machine. Strong supports at both the governor and exhaust ends are supplemented by a vertical kingpin that transmits lateral thrust to the foundation. Hot or cold—for constant operation or instant standby power, you can depend on the Type E turbine to "Stay True"!

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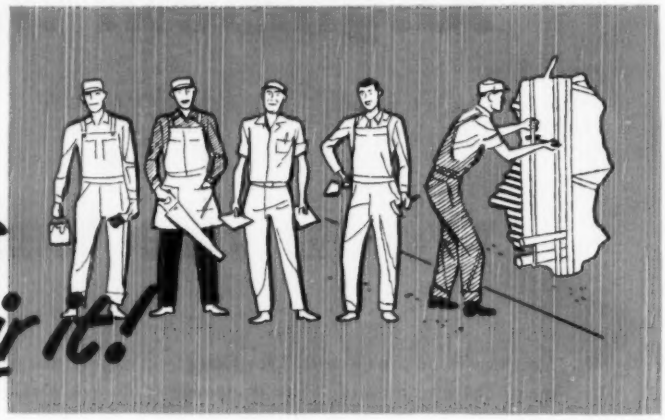
Westinghouse TYPE E Turbines

IT TAKES ONLY ONE *to install pipe*



but FIVE to repair it!

One of the most convincing demonstrations on the economy of using *durable* material is a repair job where low-first-cost material has failed—and is being replaced.

The original installation had been quickly made by pipe fitters. But the replacement calls for hours of work by as many as five crafts: pipe fitter, mason, plasterer, carpenter, painter. And this is only part of the cost story. The loss in production or utilization during the shut-down may amount to far more than the maintenance charge.

True, you pay a little more to *begin* with for Byers Wrought Iron pipe . . . but you pay a lot less to *end* with. In literally thousands of applications where corrosion costs you more than wrought iron, the use of this material is the soundest kind of economy move.

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You will find a lot of helpful information on the control of excessive maintenance through the use of Byers Wrought Iron pipe in our technical bulletin, WROUGHT IRON FOR PIPING SYSTEMS. We will be glad to send you a copy.

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POWER

PHILIP SWAIN, EDITOR • NOVEMBER 1950 • ESTABLISHED IN 1882

A Gleam Through the Smoke?

THESE DAYS IT SEEMS that a new smoke ordinance or a report on air pollution pops up each time you turn your back. There's one recent report, however, that stands out because of a refreshingly different attack on the problem of setting a standard for dust emission from boiler-plant stacks. That's the job done by a subcommittee of the Air Pollution and Smoke Prevention Association of America. In what way does this report differ from others?

Well, the members of the committee—representing enforcement agencies, fuel producers and users, and equipment manufacturers—realized that a limit on dust emission should be based on the nuisance that the stack might create. But, being intensely practical in their approach, they also realized that this can't be done except "for one isolated chimney in an otherwise perfectly dust-free neighborhood."

Of course, lots of others have come to the same conclusion. Then they've gone ahead anyway, and set up a standard tacitly based on the nuisance idea. Since what constitutes a nuisance is, of necessity, an abstraction, we naturally wind up with quite an assortment of limits—from a high of 0.75 grains per cu ft of flue gas adjusted to 12% CO_2 at 500 F, all the way to a low of 0.85 lb per 1000 lb of gas adjusted to 50% excess air.

This committee, however, comes up with another answer—one worth looking at. As they see it, a properly designed and operated plant, with dust collectors, can hold dust emission to some given level. Then they say, in effect, "We can insist that other plants do as well, but we can't require that they do better."

In other words, the committee would require every plant to limit its dust discharge to the smallest practical quantity. It would not be reasonable to require more. If, while doing the best that can be done at the existing state of the art, the plant still creates what the community considers to be nuisance, then it's up to the community to decide to live with the nuisance or to pay the cost of eliminating it.

Being practical men, the committee members realize that by using as a standard the dust-emission performance of a "good" plant, they are bringing plant size into the picture. Naturally, it is economical to do things to limit dust emission in a large plant that would be uneconomical, or even impracticable, in a small plant.

This could be gotten around, of course, by taking some kind of average performance. But an average figure would fail two ways: (1) It would still impose a hardship on the small plants, and (2) it would fail to hold large plants to the best performance they are capable of.

Wisely, we believe, the committee has chosen to vary the dust limits according to plant size. This permits weighing the cost of air-pollution prevention against total cost of plant. It requires each size of plant to conform to the highest standards practicable for it. It means each plant must do the best that can reasonably be expected of it.

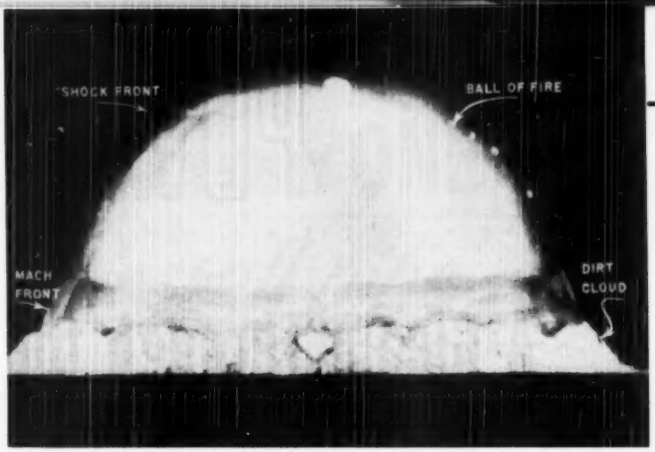
The committee proposes to take account of plant size by tying solids emission, in lb per hr, to steam generated. This latter is the average hourly output of all units connected to any one stack for that continuous 4-hr period during which average output is greatest. Output is expressed as the equivalent of steam containing 1000 Btu per lb. Soot blowing and collector rapping are allowed for by permitting the stated limits to be exceeded for a total of two hours during any 24-hr period.

In setting up the table of limits, the committee drew on all available data, allowing for such factors as character of coal, method of firing, presence of unburned carbon, reinjection and chimney height.

When it comes to test methods to check dust emission, the committee makes no specific recommendation. They do stress the need for simplified procedures and point out that expressing the limits in terms of lb per hr opens the door to such simplification. They look to work being done by other groups to achieve the desired result.

We feel that the committee realizes their proposals do not, with one fell swoop, solve the problem. Yet they have opened up a line of thinking that may be highly productive. We believe all groups wrestling with this knotty question will do well to study carefully the sample ordinance sections and table of dust limits put forward by this committee. More particularly, the reasoning by which these were arrived at is worthy of consideration. Let's have more of such practical thinking as a start toward common-sense in air pollution.

Here, in plain engineer's language, you will find the geometry and arithmetic of atom-bomb action. Part 3, concluding this series in January, shows how the bomb acts on people and property, tells you what to do about it



1 World's first A-bomb blast at Alamogordo. Ball of fire touched earth because bomb was set very low. "Mach front" results from reflection of the shock wave

How to Size Up the Atom Bomb

► PART I OF THIS SERIES told, in October POWER, why engineers must assume community and plant leadership in the technical phases of civil defense against the atom bomb. You can put the case this way: If international tensions continue, atomic bombing of key American industrial targets is a possibility. Aside from an occasional chemist or physicist, the engineer is about the only man in the average plant or community whose training fits him to understand the destructive action of this super weapon.

Among the millions who will be given instruction in civil defense measures, a certain few must be able to grasp the scientific facts behind the rule book. That's why we urge every interested power engineer to study this series carefully—to help prepare himself for leadership in this situation.

Also, if he can spare the time to study it, the public-spirited engineer should get a copy of the new source book, *The Effects of Atomic Weapons*.*

Although heavy reading in spots, and at times a bit too mathematical for the average engineer's comfort, this book unveils a wealth of useful and previously restricted information on the effects of an atom-bomb burst.

Much of the information presented in this series stems back to this remarkable source book, although we have given it a completely new expression, and have added many comments of our own.

January POWER, concluding this series of three articles, will summarize the actual effects of blast, heat flash and radioactivity on people, buildings and other "targets." It will lay the practical groundwork for an engineering understanding of civil-defense measures.

The present article, on the other hand, will steer clear of these human, economic and military angles, will talk straight engineering, arithmetic and physics, view the bomb coldly as a machine to propagate destructive waves of air shock, radiant heat, radioactivity, and gamma rays.

All Done With Circles. Because some of the technical literature of atomic energy is a maze of mathematical symbolism, many imagine that this higher math is essential to bomb understanding. Not so! Just remember that you can turn a mathematician loose in any field, and he will come up with his differential equations. That holds for the atom bomb, also for diesel engines, steam boilers, the weather, and the insurance business. Yet, in every one of these fields, men without elaborate theoretical background operate successfully.

It has been truly stated that everyday arithmetic and geometry are the most important branches of engineering mathematics. The same is true of atom-bomb mathematics. Above all, circles are the key to A-bomb understanding, so let's get at this circle business.

Fig. 2 shows a series of concentric circles with radii 1, 2, 3, 4 and 5. Choose your own units.

Now, the area of any circle is 3.14 × the radius squared. For convenience, you can take 3.14 as the unit of area. Then the areas of these five circles will be 1, 4, 9, 16 and 25, respectively.

Next, note that the space between one circle and the next is a circular band. Area of the first band is 4 − 1 = 3. Area of the next band is 9 − 4 = 5, and so on. In this way we find (column 5 of Fig. 2), that the inner circle and band areas run 1, 3, 5, 7, 9, etc.—in short, the whole series of odd numbers starting with 1 at the inner circle.

Bands of Destructivity. Here's a fact that's been known for thousands of years, still overlooked by most engineers, and of the very essence of bomb understanding. For the atom bomb, like a gigantic rubber stamp, "prints" concentric bands of diminishing destructivity on the map of its target area.

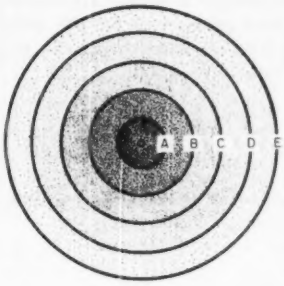
Moving out from the center, each successive band represents a lower level of *destructivity*, but not necessarily less *destruction*.

An example will make this clear. Suppose buildings of uniform character are spread evenly over the entire target area. Suppose, also, that the combined value of all the buildings in the inner circle (centered around "ground zero," the point directly under the air burst) is $10,000,000. Then the buildings in succeeding bands will be worth $30,000,000, $50,000,000, $70,000,000, $90,000,000, etc.

Now suppose, purely for the sake of illustration, that the destructivity factor is 100% in the middle circle, 70% in the next band, 30% in the following band, and zero beyond that. Then the estimated destruction will be $10,000,000 in the inner circle, $21,000,000 in the next band, and $15,000,000 in the next band—a total of $46,000,000.

*Paper edition obtainable from the U. S. Printing Office, Washington, D.C., for $1.25; clothbound edition, McGraw-Hill Book Co. $3.

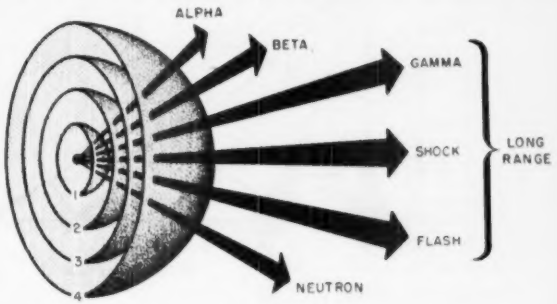
CIRCLES ARE THE KEY TO THE ATOM BOMB



CIRCLE	RADIUS	AREA	BAND	BAND AREA
A	1	1	A*	1
B	2	4	AB	3
C	3	9	BC	5
D	4	16	CD	7
E	5	25	DE	9

* Inner circle

2 Populations and property exposed in successive bands step up like the series of odd numbers, 1, 3, 5, etc



3 Civil protection considers only gamma, shock and flash. Shells 1, 2, 3, and 4 illustrate the "inverse-square" law. (See text)

Part 2

By **PHILIP W SWAIN**, *Editor of POWER*

From such examples, it is easy to see why most of the destruction and casualties occur well out from the center of the explosion.

How Radiation Fades Out. All the major bomb effects radiate in straight lines from the center of the exploding bomb—a situation made to order for circular geometry. Major considerations include radii, areas of circles and circular bands, surfaces of spheres, etc.

Imagine a gigantic spherical shell centered on the explosion. This imaginary shell is completely transparent to everything the bomb emits—the blast wave, the flash, the radioactivity. Let's see what will happen to any of these forms of radiation, *assuming no absorption by the medium through which they pass.* First, it's certain that all radiation emitted by the bomb must pass through the imaginary shell, no matter how great its radius.

Now double the radius and see what happens. The surface is quadrupled because the surface of any solid shape goes up as the square of any dimension. There can be no change in the total energy passing through the shell, but the intensity (energy passing through a unit area) will be divided by four. In the same way, tripling the radius cuts the intensity to a ninth, quadrupling it cuts it to a sixteenth, and so on. This "inverse-square" law applies equally to sunlight, candlelight, radioactivity or the sound of a factory whistle.

Next, how about absorption of the radiation by the transmitting medium? *This absorption simply serves to lower the actual intensity below that computed by the inverse square law.* For certain radiations, such as alpha and beta rays, the absorption is so great they cannot penetrate even to the ground from a high burst. Even the A-bomb's flash of radiant heat, which can be deadly at 4000 ft, suffers some atmospheric absorption on a clear day and much more on a hazy day. To sum up, the intensity of *any form of radiation* will fall off rapidly with distance *at least as much* as indicated by the series 1, 1/4, 1/9, 1/16, 1/25, etc.

Let's Look at Energy. It is no secret that, of the many pounds of U235 (or plutonium) in an atom bomb, only about 1 kilogram (2.2 lb) is actually fissioned. That is the official figure for the so-called "nominal" atomic bomb (equal to those set off at Hiroshima, Nagasaki and Bikini). When this "nominal" A-bomb explodes, 2.2 lb of atoms are split, roughly in half, producing about 2.2 lb of the lighter split atoms and releasing energy that may be expressed as 20,000 tons of TNT, 23,000,000 kwhr, or 80,000,000,000 Btu.

Uranium and Plutonium. Lightest natural element is hydrogen, element No. 1. Heaviest is uranium, element No. 92, so numbered because it has 92 plus-charged protons in its nucleus.

The most common form of uranium nucleus contains also 146 neutrons, a total of 146 + 92 = 238 nuclear particles. Hence the name "uranium 238." Another form of uranium is U235, containing 143 neutrons and 92 + 143 = 235 nuclear particles.

U238, the common form, constitutes 99.3% of purified uranium metal. Remaining seven-tenths of 1% is U235, the only natural element that can sustain a chain reaction of atom splitting (fission).

The other atomic-bomb explosive, plutonium, is a manufactured element not found in nature. The huge "reactors" at Hanford in the state of Washington create plutonium by a double transformation from U238. It is then separated chemically.

Although these two nuclear explosives, U235 and plutonium, are very different in their economics, production methods and chemical properties, they act alike as A-bomb charges. Thus, any further comments we make regarding the A-bomb will apply almost equally to U235 and plutonium.

Chain Reaction. The heavy nucleus of U235 is unstable in a peculiar way. If hit by a free flying neutron, it breaks into two parts, each of which becomes the nucleus of some lighter atom.

Splitting U235 atoms in this way releases enormous energy, about *30 billion* Btu per pound. Also, as the U235 atom splits or "fissions" it throws off two or three spare neutrons that fly around ready to split other 235 atoms. Thus, for U235 and for no other natural substance, a self-propagating chain reaction is possible if the conditions are right.

If the atom splitting is started *in a sufficiently large* piece of U235, it will sweep through the mass like fire through a dry forest. For every thousand nuclei exploded, at least one thousand more will be split by the flying neutrons set free by the previous set of explosions.

This chain reaction cannot be maintained in a small lump of U235—say one no bigger than a golf ball. Any "atomic fire" started in a piece that small will immediately die out.

Like coal on a stoker, U235 needs a fair-sized "fuel bed" to keep burning. U235 atoms won't keep on exploding

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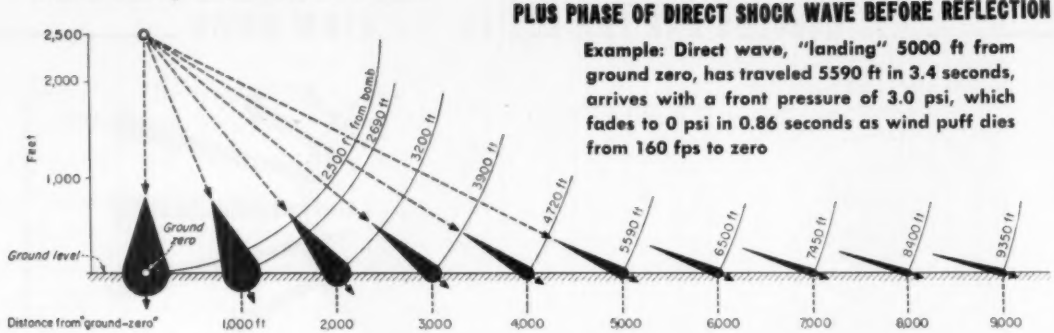

PLUS PHASE OF DIRECT SHOCK WAVE BEFORE REFLECTION
Example: Direct wave, "landing" 5000 ft from ground zero, has traveled 5590 ft in 3.4 seconds, arrives with a front pressure of 3.0 psi, which fades to 0 psi in 0.86 seconds as wind puff dies from 160 fps to zero
2,500
2,000
1,000
Feet
Ground level
Ground zero
2500 ft from bomb
2690 ft
3200 ft
3900 ft
4720 ft
5590 ft
6500 ft
7450 ft
8400 ft
9350 ft

Distance from "ground-zero"		1,000 ft	2000	3000	4000	5000	6000	7000	8000	9000
Peak pressure	12.5 psi	10.0	6.3	5.0	3.8	3.0	2.5	2.1	1.9	1.7
Front arrives in	1.0 sec	1.2	1.5	2.0	2.7	3.4	4.2	5.0	5.7	6.5
Plus phase lasts	0.54 sec	0.57	0.63	0.69	0.78	0.86	0.92	0.99	1.04	1.08
Wind velocity	480 ft per sec	450	300	250	200	160	130	110	95	85

4 Shock wave moves out through unobstructed atmosphere as here shown. Width of conventionalized "slugs" represents peak pressures corresponding to vertical front of shock. Reflection at ground more than doubles tabulated peak pressure

each other unless they are huddled together in a substantial bunch called the "critical mass." This mass is a secret, but, according to the official Smyth Report, is greater than 2 lb and less than 200 lb.

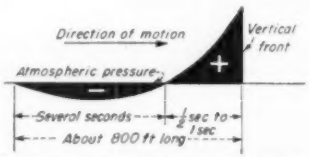
Here's the explanation, greatly briefed: Matter is mostly open space, a 3-dimensional "sieve." If you start atoms exploding in the U235 golf ball, the reaction immediately dies out because too many drone neutrons escape to the surface without hitting any atomic nuclei.

Now imagine adding layers of U235 to build the golf ball to a bigger size. The larger the lump the less the chance of escape for any given neutron, so that increasing percentages find their targets. Finally, the growing ball of U235 attains the critical mass. At this point, for each thousand atoms split, the flying particles make at least one thousand new hits so the chain reaction can continue by itself without outside help.

How Bomb Explodes. It is clear that a practical A-bomb must contain considerably more than the critical quantity of U235 to explode at all. Yet to prevent spontaneous explosion by stray neutrons from the atmosphere, this must be divided into two or more pieces, each of which is smaller than the critical.

To set off the explosion, the pieces are thrown together at enormous speed and surrounded by heavy tamping material to delay their separation as long as possible.

Both the high-speed assembly and the tamper are essential because the mass must be held together for a brief instant despite the explosive forces tearing it apart, since as soon as the mass is "disassembled" the chain will die.



5 Shock wave moves somewhat faster than normal sound. Pressure is highest when vertical front arrives. Negative phase is longer but is less violent

At best, only a small fraction of the explosive charge can be fissioned before the reaction terminates itself by dispersal of the critical mass. The nominal bomb presumably contains many times 2.2 lb of U235. Thus, when only 2.2 lb is fissioned, the remainder of the explosive, though scattered over the landscape, retains its full quota of available energy. To put it another way, even the best atomic bomb wastes far more energy than it releases. And perhaps it is just as well that way.

Of the 23,000,000 kwhr of energy released in a few seconds, about one third rushes out as thermal radiation with the speed of light. Nearly two thirds fans out in the shock wave. A small percentage is radiated as alpha, beta and gamma rays and neutrons.

An additional substantial quantity of energy (not counted in the 23,000,000 per hr) remains as residual radioactivity in the fission products (split atoms) to be emitted gradually over a substantial period of time.

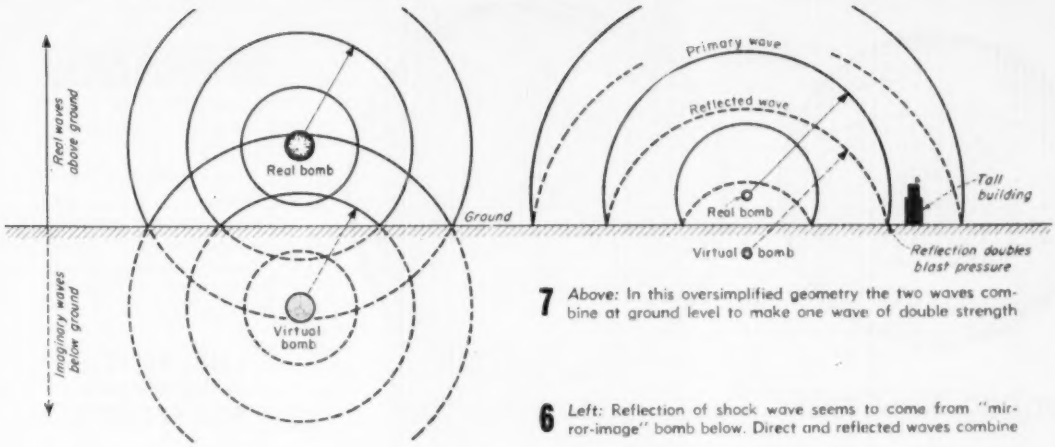
Of the four forms of direct radioactivity from the bomb burst, alpha rays are bundles of alpha particles, each containing two protons and two neutrons. Beta rays are flying electrons. Gamma radiation is electromagnetic and similar to hard X-rays. Neutron radiation is what the name implies, flying neutrons.

As far as casualties from the burst itself are concerned, only gamma radiation is important. Alpha and beta rays cannot penetrate even to the ground from a high burst. If a man is close enough to be injured by the neutrons, he will be killed by gamma rays.

Yet all types of radioactivity may be dangerous where a man comes in direct contact with the fission products, the highly radioactive split atoms. Some of these radioactive isotopes lose half their potency in a fraction of a second. Others have a "half life" of thousands or even millions of years. Taken as a mixture, these fission products are violently radioactive for a short time. Measurable radioactivity lingers for years.

Fortunately, in the typical high air burst, these deadly fission products are mostly carried up and away harmlessly by the gigantic chimney effect. Residual radioactivity is not ordinarily a real danger except for a low or underwater burst.

Air Burst Described. An atom bomb may explode high in the air, low in the air, on the ground, under the ground, above the water, or under the water. Also, it may explode at various levels above or below the ground or water. Each such case is a special study. Contrary to popular notions, however, the greatest threat to American industrial targets is not the low air burst or the underwater burst, but the high air burst, 2000 to 2500 ft above the



7 *Above:* In this oversimplified geometry the two waves combine at ground level to make one wave of double strength

6 *Left:* Reflection of shock wave seems to come from "mirror-image" bomb below. Direct and reflected waves combine

surface. We shall, therefore, describe this in some detail.

For a tiny fraction of a millionth of a second, the entire energy released by the bomb detonation is confined to a few pounds of matter. Resulting temperature is about 2,000,000 F, accompanied by a pressure measured in millions of pounds per square inch.

Almost instantly, this heat energy is shared with all the materials of the bomb, converting them to an immensely superheated vapor which, in turn, heats the surrounding air to incandescence.

After a few millionths of a second, the detonated bomb begins to appear as a luminous sphere, the "ball of fire." At the end of one ten-thousandth of a second its diameter is 90 ft and its temperature about 500,000 F.

A spherical pressure wave, "the shock wave," rushes out as the gases confined in the ball of fire attempt to relieve their enormous compression by expansion. For an instant, the shock wave hangs on the surface of the ball of fire, then rushes ahead of it.

In fifteen-thousandths of a second the ball of fire is 600 ft across and its outside temperature down to 9000 F, although the inside is very much hotter. By this time, temperature and pressure of the shock wave have fallen to a point where the air through which it travels is no longer rendered luminous. The luminous air is opaque to heat radiation from the ball of fire, but when the air ceases to glow it becomes transparent to the thermal rays, which then pass through to do their deadly work on people and structures. At this moment, when the ball of fire is unveiled to the outer world, the shock wave is traveling at a speed of nearly 3 miles per second, but slowing down rapidly.

At the end of one second the ball of fire has reached its maximum diameter of 900 ft. The shock wave is now 600 feet out ahead.

After ten seconds the ball has risen about 1500 ft like a hot-air balloon, the shock wave has traveled about 12,000 ft, and the bomb has completed its initial work of destruction.

Low Burst Less Effective. Since the maximum radius of the ball of fire is about 450 ft, the bomb must be detonated above that level if it is not to touch the earth's surface. It is true that touching the earth's surface increases the residual radioactivity on the ground. Yet this offers no military advantage because structures and people immediately beneath the bomb are destroyed in any case. Over-expenditure of energy in this area merely reduces the damage further out where it could be useful.

Eventually, the ball of fire cools, the vaporized constituents (fission products, unexploded U235 or plutonium, bomb materials, etc) condense. If the ball of fire has touched the ground, the cloud of solid condensate will also include condensed vaporized dirt and debris.

Fortunately, this deadly material is not likely to cause any casualties in a high air burst. The chimney effect of the explosion will carry this radioactive cloud several miles straight up into the sky. By the time the particles fall out they will have spread so thin (and have been so reduced in potency) they will offer little hazard.

Underwater Explosion. Unlike the air burst, the underwater burst deposits dangerous residual radioactivity on the surface. Nevertheless, the high air burst is normally much more effective against both structures and human targets. This would hold true even if test "Baker" at Bikini, in a lagoon 200 ft deep, could be duplicated in the typical shallow harbor or river alongside American industrial and military atom-bomb targets.

Yet it is necessary to consider the possibility of this type of attack if the enemy should be unable to carry out a high air blast and so should be compelled to use an inferior substitute.

At Bikini the ball of fire was undoubtedly formed even under water. Then the gas bubbles broke through the surface, started expanding and soon cooled below the luminous temperature. Next, shock waves shot out through the air, creating a rapidly expanding circular slick on the water's surface.

As the pressure of the giant gas bubble was relieved water rushed into the cavity. Then water drops were thrown up as a hollow cylinder or chimney of spray known as the "plume."

Plume Rises 8000 Ft. At Bikini the plume rose to 8000 ft. Its greatest diameter was about 2000 ft, its maximum wall thickness about 300 ft. Water lifted totaled about a million tons. The "mushroom" or cauliflower-shaped cloud that topped the plume contained some of the fission products and other bomb constituents, as well as great quantities of water drops.

As the column of water and spray fell back into the lagoon there developed at the base of the column a giant wave of thick mist about 1000 ft high. Beginning to form in about ten seconds, this doughnut-shaped watery mass expanded rapidly. Eventually it lifted from the surface of the lagoon to form a mass of clouds several thousand feet thick. A moderate to heavy contaminated rainfall moving down wind and lasting nearly an hour, developed from this cloud mass.

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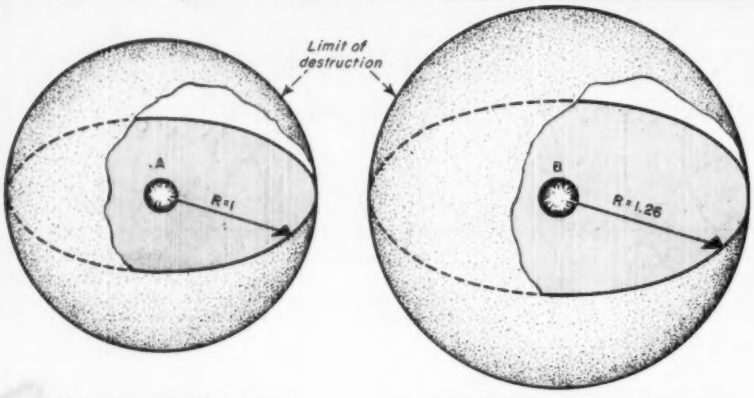


BOMB	A	B
ENERGY	1	2
VOLUME	1	2
RADIUS	1	1.26
GROUND AREA	1	1.58
EFFICIENCY	1	0.79

RELATIVE DIMENSIONS AND EFFECTS

8 Doubling bomb's energy doubles volume of the sphere of destruction, but land area of destruction (the true measure) grows only as the square of the cube root. Cube root of 2 is 1.26. This squared is 1.58. So doubling bomb gains 58%

Popular impression rates the underwater bomb more deadly than the air burst. Bikini's spectacular water upheaval and residual radioactivity's dread mysteries have unduly influenced public opinion. Yet direct gamma rays from the air burst would probably kill more people than the waterburst residual. Certainly heat and shock would be far more destructive.

The Shock Wave. In the popular mind an atom-bomb strike suggests pressures of the order of thousands, even millions, of pounds per square inch. While these do exist for an instant in the immediate neighborhood of the bomb, such pressures never touch any appreciable area of the target. In fact, pressure on the ground directly below a burst 2500 ft up is only about 40 psi. At 4500 ft from "ground zero" it is down to 10 psi.

Applying this pressure to the large areas of building walls and roofs, engineers will understand how great it really is. For example, 10 psi will push on a 20x20-ft house wall with a total force of 288 tons, enough to cause instant collapse. Remember, hurricane-wind pressures are far less than 1 psi.

Blast-wave air pressures of 2 to 10 psi are sufficient to damage most man-made structures. Pressures above 15 psi could theoretically do greater damage, but they serve no useful purpose since a lesser pressure will complete the destruction of all normal targets. Moreover, pressures above 15 psi are confined to a small area close to ground zero.

Of the total casualties and structural damage in an atom-bomb explosion over an area target, the major part will be accomplished by pressures of less than 15 psi. This corresponds, also, to observations made by the writer at Bikini and reported in POWER at that time.

The shock wave moves out as in a spherical shell, gradually changing its wave form as it proceeds. Fig. 4 shows the evolution with distance. Almost from the start, the wave front is vertical; it strikes an object immediately with maximum wave pressure — no buildup.

Close to ground zero, the entire shock wave is positive (above atmospheric pressure), but at 1500 ft it has already developed a well-marked negative or suction phase. From here on, Fig. 5 represents the general shape and length of a shock wave.

Picture this as moving toward a target at the right. Highest pressure is attained the moment the wave touches the object. Then pressure slides down to atmospheric and below before returning to normal.

Note that maximum pressure in the positive phase is higher than in the negative, but the negative phase lasts longer. Each phase is accompanied by its own wind, a forward wind for the positive phase and a backward wind for the negative phase.

When the wave has traveled so far that the peak pressure is down to 10 psi, its positive phase will extend about 1000 ft and require half a second to pass a given point. The negative phase will be longer and last several seconds.

Peak Pressures. With an atom bomb, as distinguished from a TNT bomb, pressure lasts long enough so damage is determined primarily by the *intensity* of the peak pressure rather than by the *duration* of the pressure wave.

Ordinary sound travels at a velocity of about 1100 fps. The shock wave starts out much faster than this, but by 3000 ft from ground zero it has fallen about to the velocity of sound.

It is important to distinguish between the shock *pressure* and the shock *wind*. Shock waves, like ordinary sound waves, vibrate longitudinally. That is, the particles vibrate back and forth in the direction of wave propagation, rather than crosswise, as with light or waves on the surface of water. With the tremendous shock waves from an A-bomb, the particle movement can be many yards as compared with inches or fraction of an inch for ordinary sound waves. This long movement constitutes a short tremendous puff of wind. Fig. 4 shows the maximum velocity and duration of the forward winds.

Bigger Bombs? All the foregoing has been presented on the basis of the so-called "nominal bomb" equaling 20,000 tons of TNT, like those set off over Japan and at Bikini.

Since more powerful bombs can be made, we need some way to translate the present findings to fit some future bomb of greater strength.

For shock-wave effects, the scaling factor will be the cube root of the energy. First, take the cube root of the factor by which the bomb strength is multiplied. Multiply by the distance at which any given blast effect would occur with a nominal bomb to get the distance at which the same effect would occur with the more powerful bomb.

For example, suppose the new bomb has double the strength of the nominal bomb. The cube root of 2 is 1.26. Since $4000 \times 1.26 = 5000$ ft (about) the double-strength bomb will produce at 5000-ft radius the same effect as the nominal bomb at 4000 ft. See Fig 8.

While substantial increases in bomb strength are undoubtedly possible, it seems unlikely that the strength of the nominal U235 or plutonium bomb can be multiplied many times. Unless the fissionable material is divided into more than two parts, the total charge in the bomb must always be less than double the critical to avoid spontaneous explosion. Dividing the fissionable material into more than two parts to allow a heavier charge would pose the almost impossible task of bringing them all together at the same instant.

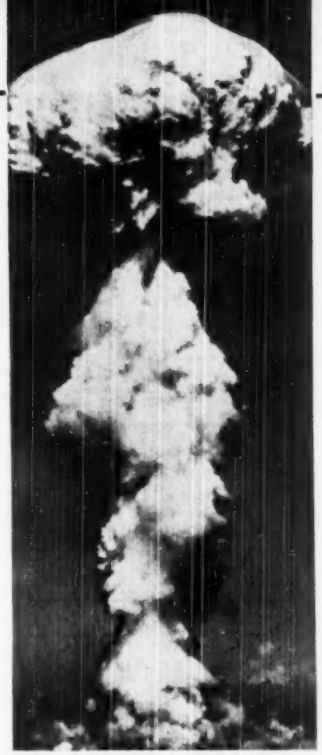
Undoubtedly there will be continued progress in increasing bomb efficiency —that is, the percentage of total charge actually fissioned. But here, also, we are limited by the very nature of an atom bomb. It appears almost impossible to design an A-bomb that will fission a major part of its charge before disintegrating.

Only the hydrogen bomb might offer a big multiplication factor, but it is not yet known whether a hydrogen bomb can be produced. If it can be, the cube-root law will still apply to the shock effects. That is, if a hydrogen bomb could be made, say, 64 times $(4 \times 4 \times 4)$ as powerful as the nominal A-bomb, its destructive radius for any given kind of damage would be multiplied by 4 and the corresponding area of destruction by $4 \times 4 = 16$.

The computation illustrates a significant fact: *the more powerful the bomb the less is the area destroyed per unit of energy.* That is, big bombs are less *efficient* than small as instruments of destruction.

Shock-Wave Reflection. The volume, *The Effects of Atomic Weapons*, primary source of information in these articles, devotes much space to a mathematical study of the reflection of the shock wave from the surface of the earth. At and near ground level, primary wave and reflected wave combine to produce a single wave of double pressure, except close to ground zero where the pressure is more than doubled.

So great is the length of the shock wave that trees and buildings of ordinary size do not appreciably disturb the reflection. Thus the average built-up city area will reflect the shock wave almost as perfectly as a treeless plain. Hills and mountains, however, greatly alter the reflection.



9 After high air burst, 5-mile-tall cloud (as here at Bikini) disperses the radioactive fission products

Authorities agree that a high air burst is much more effective than a ground burst. Here's why: The energy delivered to the contacted surface by a ground burst is excessive and wasteful at this point. It leaves less energy for points farther away. Moreover, the high burst reduces the protective effect of shadows.

It is true that raising the bomb, say, 2500 ft above the ground increases its air-line distance from any object on the ground, but the percentage increase is not important except close in where it is not a matter of concern. Finally, reflection acts more effectively with a high burst.

At any point well out from ground zero, the true and reflected shock waves fuse to produce a double strength wave front (Fig. 6 and 7) at ground level, as already noted. The two wave fronts, arriving together as a single big blow are much more effective than as two separate smaller blows.

At the top of a tall building there may be some separation of the primary and reflected waves. In that case, the top will first receive the peak blow from the primary shock wave and, a fraction of a second later, a somewhat greater blow—a combination of the front of the reflected wave with the remainder of the primary wave. Designers and other readers interested in a detailed and mathematical analysis of the complex-phenomena of shock-wave reflection should refer to our source book, *The Effects of Atomic Weapons.*

Heat Rays. Radiation from an atom bomb is both thermal and nuclear. Since any discussion of nuclear radiation is closely associated with its effects on people, the subject as a whole will be deferred to the final article. The present chapter deals only with thermal radiation—radiant heat emitted by the white-hot ball of fire.

Although the blast is responsible for most of the physical destruction, heat radiation contributes greatly to the total damage by igniting combustible structures and starting fires. Moreover, the intense flash of radiant heat is a prime cause of death and injury through skin burns.

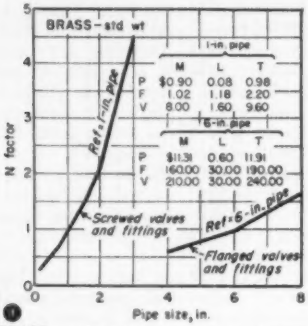
When the nominal A-bomb explodes, 8,000,000 kwhr (one third of the total energy release) move out as radiant heat with the speed of light. A complicated mathematical analysis, of the falling temperature of the surface of the ball of fire and of the varying transparency of the intervening air, shows that the radiant heat delivered to an object several thousand feet away from ground zero is spread rather evenly over a period of about three seconds.

According to the inverse square law, the intensity of this radiation must fall off rapidly with distance. For example, at 6000 ft it cannot possibly be more than one ninth as much as at 2000 ft. Actually, the rate of fading is substantially greater than this, and much more for a hazy day than for a clear day. Thus, if the day is clear many more people will be injured and killed by thermal radiation.

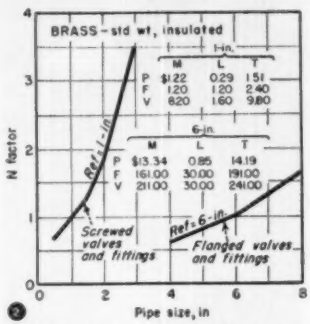
Next the Application. We now have in hand the basic information about how a bomb acts to disseminate gamma rays, shock wave, and radiant heat.

In the concluding article, January POWER, we shall see how these act to kill and maim people, to damage or destroy structures, to trigger further destruction through fire. We shall also see what can be done to save lives and property. It can be said right here that substantial protection is possible. At best an atom-bomb explosion will still kill thousands and destroy millions of dollars' worth of property, but the death and destruction can easily be cut in half by proper understanding and preparation—accomplished, we hope, with the active cooperation of power engineers.

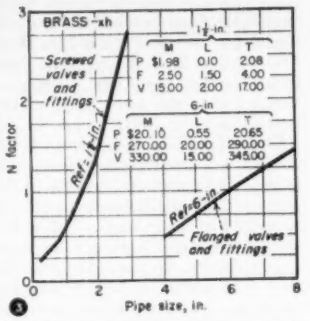
ESTIMATE BRASS-PIPE COST WITH FIRST 5 PLOTS, CI WITH LAST



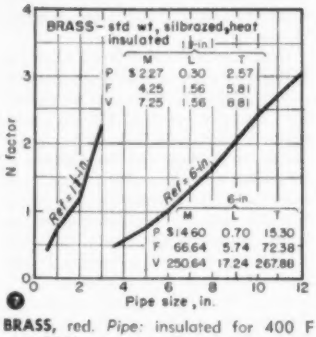
1 **BRASS,** red. *Fitting:* to 3 in. bronze screwed 125 lb, 4-8 in. flanged 150 lb. *Valve:* bronze scr gate 200-lb cold-water press (cwp); bronze fl gate 150 lb



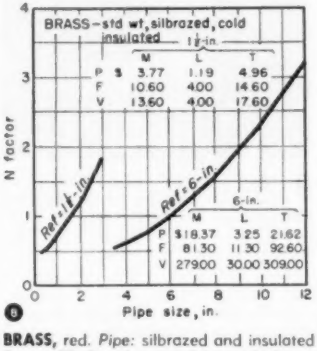
2 **BRASS,** red. *Pipe:* insulated for 400 F with 85% magnesia 1½ in. thick to 3 in., 2¼ in. thick 4 to 8 in. *Fittings* and *valves* are same as in Fig. 1



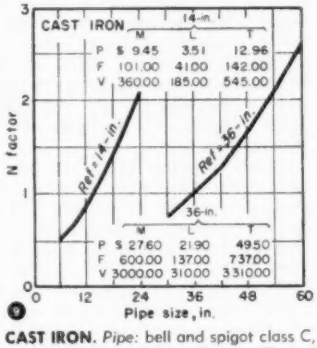
3 **BRASS,** red. *Pipe:* bare. *Fitting:* ¼-3 in. bronze-screwed 250 lb, 4-8 in. brass-flanged 250 lb. *Valve:* Bronze scr gate 300 lb, brass fl gate 250-lb cwp



7 **BRASS,** red. *Pipe:* insulated for 400 F with 85% magnesia. *Fittings* and *valves* are the same as in Fig. 5 for sizes to 3 in. and sizes 3½ to 12 in.



8 **BRASS,** red. *Pipe:* silbrazed and insulated 0 to –25 F with special brine-thickness cork. *Fittings* and *valves* same as Fig. 5 for sizes to 3 in. and 3½ to 12 in.

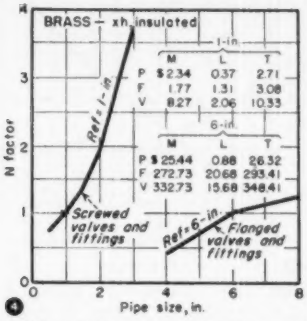


9 **CAST IRON.** *Pipe:* bell and spigot class C, tar coated, 6 to 60 in. *Fitting:* CI, bell and spigot, class D. *Valve:* CI, bronze mounted os&y flanged gate 125 lb

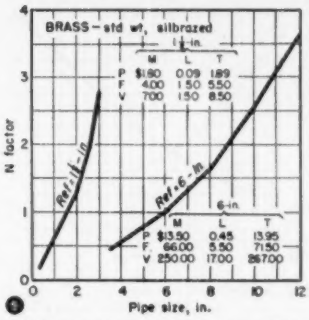
HOW TO FIGURE PIPE COSTS

Accurate and easy method for estimating piping costs in power, industrial, refrigeration and similar plants. R A Dickson, engineer, of Caldwell, N. J. presents his *N* system for estimates. These 24 charts and the practical piping problem he works out can be used in either your office or in your plant

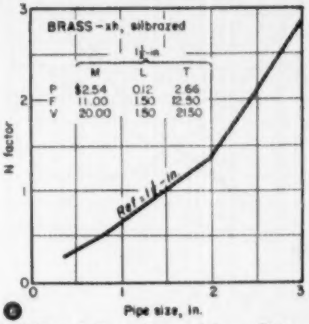
MORE PLOTS FOR BRASS; OTHERS FOR DURIRON, GLASS AND LEAD



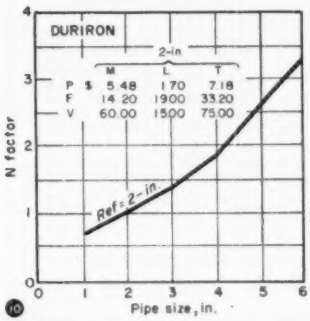
BRASS, red. *Pipe:* insulated with sponge felt and Superex for 800 F. *Fitting:* same as Fig. 3. *Valve:* same as Fig 3, except pressure rating, which is 300 lb



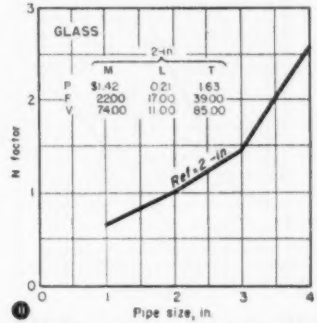
BRASS, red. *Pipe:* silbrazed, bare. *Fitting:* brass, silbrazed. *Valve:* to 3 in. bronze, silbrazed; 3½-12 in. bronze-flanged wedge gate os&y. *Flanges:* brass 150 lb



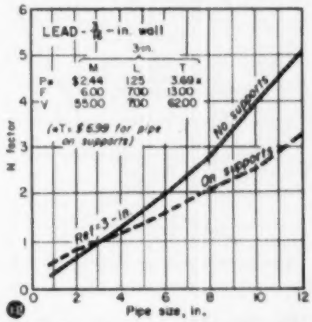
BRASS, red. *Pipe:* silbrazed, bare. *Fitting:* brass with silbrazed ends, 250 lb. *Valve:* bronze gate with silbrazed ends, 300-lb pressure rating



DURIRON, *Pipe:* split flanged, bare, 3 ft long to 1½ in., 4 ft for 2 in., 5 ft to 6 in. *Fitting:* DI split flanges. *Valve:* DI lubricated-plug, straightway, flanged



GLASS, *Pipe:* Pyrex glass, 10-ft lengths, 1-4 in. bare. *Fitting:* Pyrex glass. *Valve:* is type 316 stainless steel, flanged gate, Series 15. *Flanges:* CI



LEAD, *Pipe:* sizes ¾-12 in. *Fitting:* lead, plain ends. *Valve:* lead, bolted bonnet Y-type, flanged. *Flanges:* Series 15, steel, slip-on

► PIPE-COST ESTIMATING can often be a headache, especially when you have insufficient data on costs, layout or length of runs. In my work I've done quite a bit of cost estimating and have learned to save time and labor by cutting corners. Results can be approximate or accurate, according to cost figures used. Here's how it works.

Basis of Method. My method, called the *N* system, is based on the simple idea of recording, once and for all, relative costs of various sizes of the same kind and class of pipe made up into a "string" consisting of pipe, fittings and valves. If one string of pipe taken as standard costs *X* dollars, and the same string made of another size of the same kind of pipe costs *Y* dollars, both installed, then $X/Y = N$.

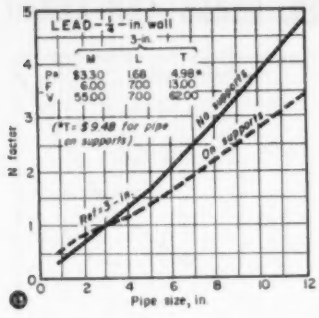
N factor for each size can be found by actually figuring cost of each string and comparing it with the cost of an arbitrarily chosen standard or "reference" string. Factors are then recorded in a tabulation or plotted against nominal pipe size as in this article. Plots obtained are more or less smooth curves.

Some of these curves may not be exactly smooth. This is unimportant because tests show that relative costs vary but slightly even when absolute costs vary widely. This means that with a table or plot of *N* factors for any kind and class of pipe it is only necessary to keep up with cost variations for the reference size.

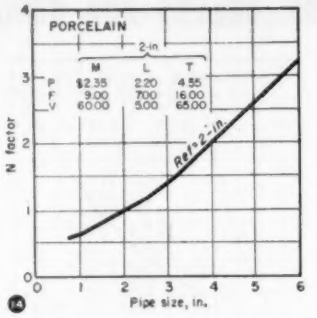
Curves. The main contribution this article makes is a group of 24 charts with a total of 271 *N* factors. Some are for bare pipe, some for 400-F, 800-F, and 0 to –25-F insulated pipe. Both Schedules 40 and 80 are covered. These have different classes of insulation. Factors given apply to piping used in power-plant, process, air-conditioning, plumbing, refrigeration and similar work. Other charts, not presented here, were made up for special alloys, zephyr-weight grades and certain other special materials. For foreign plants where odd sizes, 5, 7 or 9 in., are used, 14 factors can be interpolated from charts.

Besides the *N* factor, material and labor costs for the reference size are given in each *N*-factor plot. These are based on July 1949 costs in the New York area. Data are presented as material, labor and total for (a) 1 ft of pipe, (b) one fitting, figured as a tee, and

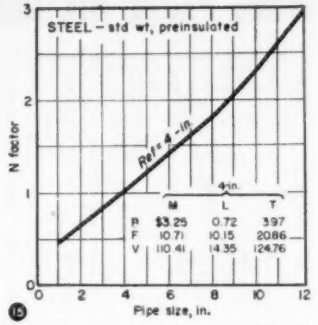
HERE ARE N-FACTOR PLOTS FOR LEAD, PORCELAIN AND STEEL



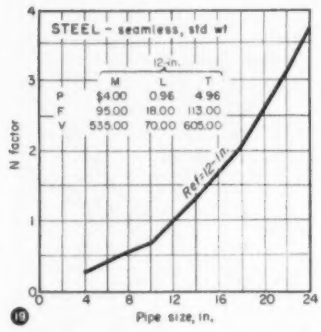
LEAD, *Pipe:* sizes ¾-12 in., 10-ft lengths. *Fittings* and *valves* same as Fig. 12. Unsupported pipe considered laid on existing supports or ground



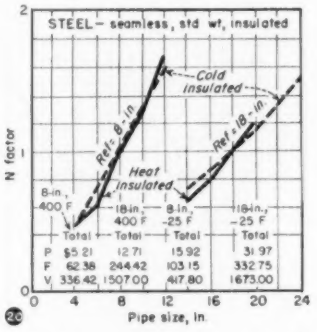
PORCELAIN. *Pipe:* chemical porcelainware with flared ends, 5-ft lengths, ¾-6 in. *Fittings* and *valves* are all chemical porcelainware



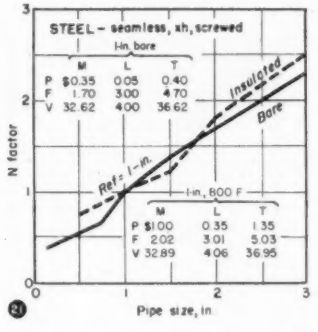
STEEL. *Pipe:* seamless black, Ric-Wil, 1-12 in. insulated 1½ in. thick for 300 F. *Fitting:* 150-lb steel, welding type. *Valve:* cast-steel flanged gate, Series 15



STEEL. *Pipe:* black, bare; 4 to 10 in. Sch 40, 12-24 in. 0.375-in. wall. *Fitting:* 150 lb, steel welding. *Flanges:* forged steel *Valve:* cast-steel flanged-gate, Series 15



STEEL. *Pipe:* insulated 400 F with 85% magnesia, 0 to –25 F heavy-duty thickness cork. *Fittings* and *valves* are the same as in Fig. 19



STEEL. *Pipe:* black, bare. Insulated 800 F with 85% magnesia and Superex. *Fitting:* forged-steel screwed 2000-lb cwp. *Valve:* forged-steel gate, screwed 600-lb cwp

(c) one valve of type specified in chart caption. In the original calculation each string was figured as 1000 ft of pipe having one fitting and one valve. If this hadn't been done it would be impossible to allocate costs of welding, pipe fitting, bolting up flanges and other factors to a single ft of pipe. Costs of material and labor chargeable to the pipe were then divided by 1000 to give cost per ft of pipe.

How to Use Charts. We can use either current price data with these charts or cost data given on each chart. If you use chart costs results will not be as accurate as with current costs. Degree of accuracy will depend on how closely you can "factor" July 1949 costs to actual date of use. Unfortunately there are no satisfactory methods regularly available for converting piping costs of one date to those of another. Usual cost indexes do not apply to piping.

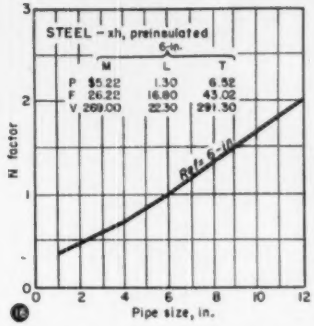
The Marshall and Stevens indexes of comparative equipment costs regularly published in *Chemical Engineering* probably are a fair indicator of piping cost variations for process industries. Some engineers use the *Engineering News-Record* construction-cost index, either as is or with modifications developed by the user. It is likely, however, that none of the various index series published by Government bureaus and other organizations in the monthly *Survey of Current Business* is a particularly good indicator for pipe. So far as I know only the privately circulated *Handy Index of Public Utility Costs* contains an actual piping-cost index.

Whichever method you employ the *N*-factor charts are used in exactly the same way. First, you figure cost of the reference string as so many feet of pipe, so many fittings and so many valves. Handle a manifold as a string. Reference size is that size for which the *N* factor on the applicable chart is unity. Then the in-place cost for any comparable string of the same kind and class of pipe, but of different size, equals cost of reference string, times the *N* factor for the size in question.

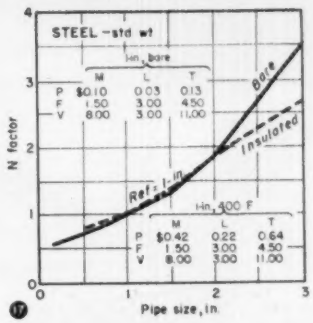
Example. What will be the cost of 500 ft of 10-in. pipe containing four fittings and three valves if pipe is extra-heavy seamless steel insulated for 800 F? Assume that July 1949 cost data are satisfactory without modification.

Solution. Referring to Fig. 23 we find

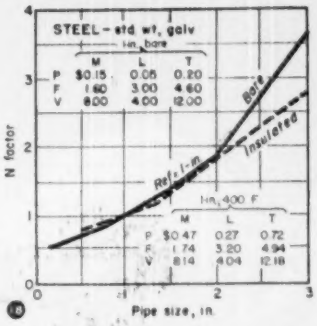
USE FIRST 5 PLOTS FOR STEEL PIPE, LAST FOR RUBBER-LINED STEEL



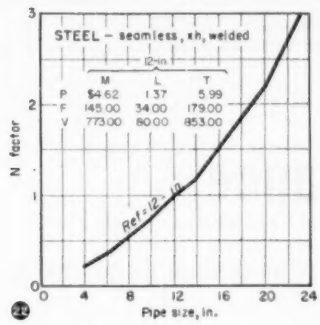
STEEL. *Pipe:* seamless black, Ric-Wil, 1-12 in. insulated 2 in. thick for 500 F. *Fitting:* 300-lb steel, welded. *Valve:* cast-steel flanged gate, Series 30



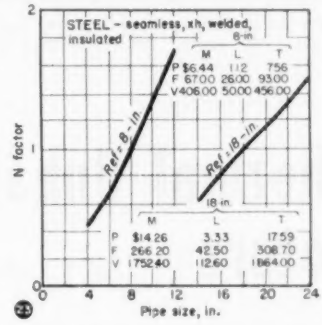
STEEL. *Pipe:* butt welded, bare and 400 F standard thickness 85% magnesia. *Fitting:* forged-steel screwed 2000-lb cwp. *Valve:* bronze gate screwed 200-lb cwp



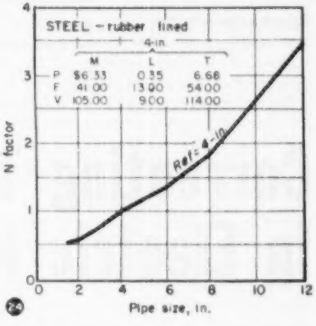
STEEL. *Pipe:* butt welded, bare and 400 F standard thickness 85% magnesia. *Fitting:* malleable iron galvanized screwed. *Valve:* bronze screwed gate 200-lb cwp



STEEL. *Pipe:* black, bare; 4-10 in. Sch 80, 12-24 in. 0.625-in. wall. *Fitting:* XH, welding. *Valve:* cast-steel flanged gate, Series 30. *Flanges:* forged, Series 30



STEEL. *Pipe:* insulated 800 F with 85% magnesia and Superex. All *Pipe, Valves* and *Fittings* are the same as given in the caption for Fig. 22



STEEL. *Pipe:* lined with 3/16-in.-thick rubber. *Flanges:* made on, 1½-12 in. *Fitting:* Cl 125 lb, rubber lined. *Valve:* standard Ace rubber-lined flanged gate

that the reference size is 8 in. Total cost for reference string is 500 ($7.56) + 4($93.00) + 3($456.00) = $5520.00. Entering the chart at a pipe size of 10 in. we find the *N* factor is 1.32. So the cost of the 10-in. pipe with fittings and valves is 1.32($5520) = $7286.40. From this example you can see how easily and quickly pipe costs are estimated by use of *N*-factor plots.

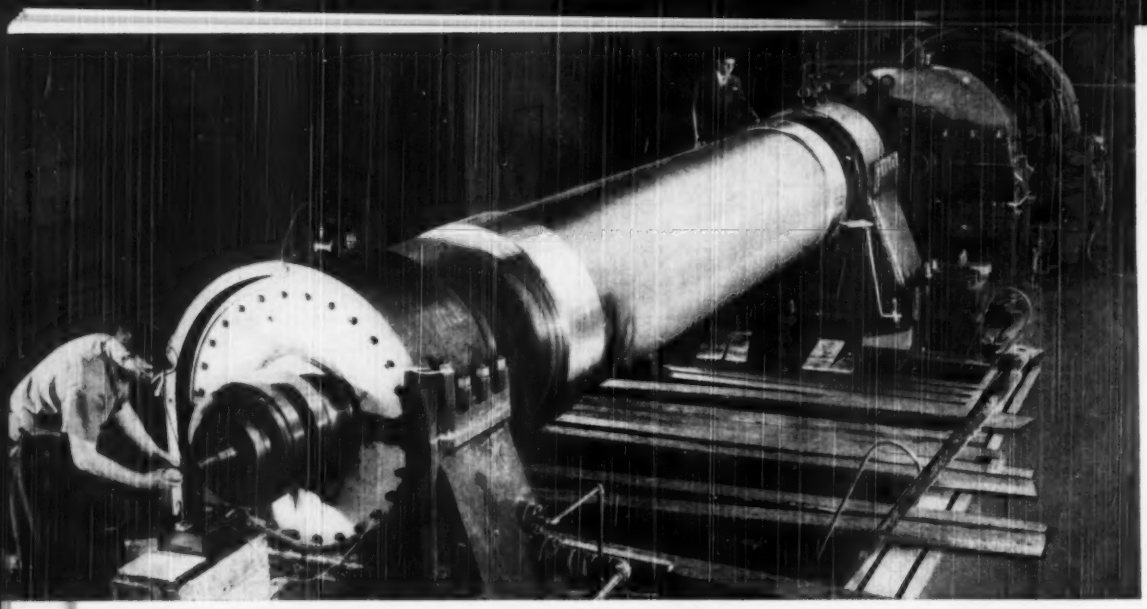
Procedure. To make best use of *N* factors there are a few facts about the charts that should be kept in mind. Knowing how I derived these factors there will be little chance of your going astray when using them.

In welded lines the cost of a flanged joint is included for each 200 ft of run. In any string having a screwed valve, provision is made for a union adjacent to the valve. In screw-joined strings the cost includes necessary couplings, and in flange-joined strings, all necessary flanges, as well as bolts and gaskets. Allowance is made for handling and hauling all parts, for pipe fitting, welding, weld rod, calking material in bell and spigot joints and screw ups of both screwed and bolted joints. Insulated strings include the cost for both material and labor in insulating each part with 85% magnesia for 400 F, 85% magnesia and Superex for 800 F and special brine-thickness cork for 0 to −25 F insulation.

In all except one case material cost (*M*), labor (*L*) and total (*T*) have been listed directly on the chart for 1 ft of pipe (*P*), one fitting (*F*) and one valve (*V*). Where space was insufficient, only total costs were listed.

Note that the *N*-factor plots cover only the cost of the pipe string itself and do not include the cost of burying or supporting the line. These costs are too variable to include in the charts. Calculation is not difficult. Many installations are supported on existing structures or laid on the ground.

This article presents in abridged and somewhat different form the data on pipe-cost estimation by the author which will appear in the forthcoming book *Industrial Piping*, by C T Littleton and R A Dickson, to be published early next year by McGraw-Hill Book Co. A longer and more extensive article on this subject by the same author appeared in *Chemical Engineering*, Jan 1950, pp 123 to 135.

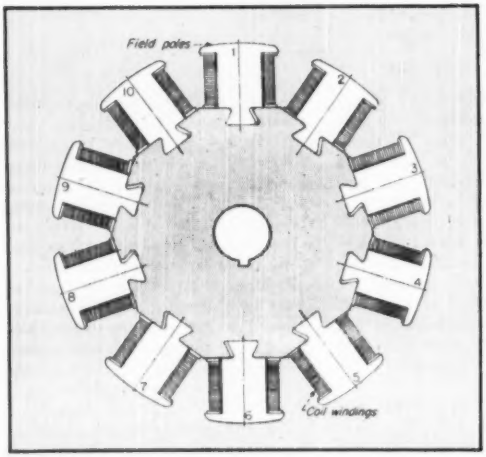


GENERATOR ROTOR above is thermally balanced by plugging vent openings till rotor temperature equalizes. With salient-pole machines you rearrange dc field poles (on paper first!) till you arrive at more even temperature distribution, Fig. 3

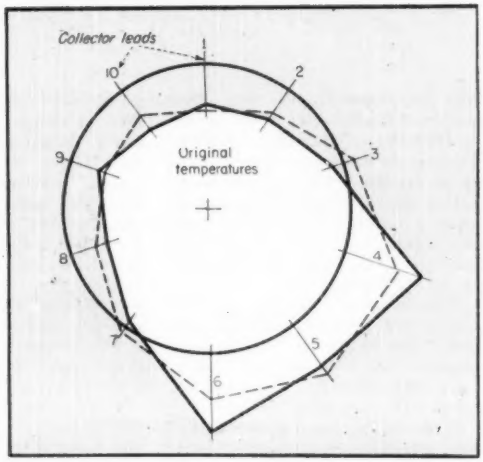
Correcting Thermal Unbalance In Electric Rotors

By **W F KING**, *Mechanical Engineer, Allis-Chalmers Mfg Co*

THERMAL UNBALANCE DETECTED BY A CHANGE IN VIBRATION AS...



1 To lay out heat patterns first check temperatures at each pole face, then dovetail right after rotor comes to rest



2 Circle represents rotor mean temperature (not to scale). Broken lines connect temperatures at dovetails while . . .

Effect of a slight difference in temperature across the diameter of rotor is not generally appreciated. Dissymmetry in temperature of one degree in a long rotor can cause unbalance and consequent vibration

► WE MAY DEFINE thermal unbalance in generator rotors as the effect of nonuniform heating or cooling of the rotor body. Of course, it is present to some limited extent in all electrical machines, but it is usually too slight to be troublesome. It is not surprising that it does occur in view of the dissimilar materials in the rotor and the complex heat-flow paths.

Symptoms. Where thermal unbalance is minor, suitable correction can be made by mechanical balancing at optimum operating conditions. But where thermal unbalance is large, definite thermal corrective steps must be taken. Otherwise, if the rotor is balanced mechanically at operating temperature it will be unbalanced at other temperatures. Furthermore, the bow of the shaft, which is not corrected by the addition of balance weights, will cause eccentricity at the coupling or shaft extension, and axial vibration at the bearings.

Thermal unbalance can be detected and distinguished from other causes of vibration by its characteristic behavior. This unbalance will change with rotor temperature. Changing a factor affecting rotor temperature, such as the field current of a synchronous machine, produces a gradual change in the unbalance. This continues until the rotor temperature becomes stable. Time interval from the change in operating conditions when the vibration remains uniform, may be one-half hour or several hours depending on size (thermal capacity) of rotor.

Failure to take this time lag into account may lead an observer to describe the unbalance as erratic. If vibration changes immediately upon changing the field current, unbalance is caused by a defective field winding. If vibration changes immediately upon change in load, it can be attributed to a faulty coupling or a load effect on the prime mover.

Shaft bowing from thermal unbalance can be detected by checking the shaft runout at different rotor temperatures. Runout should be checked as far from the bearing as possible. The bowed shaft will produce axial forces on the pedestal. Axial vibration will be large compared to horizontal and vertical vibration.

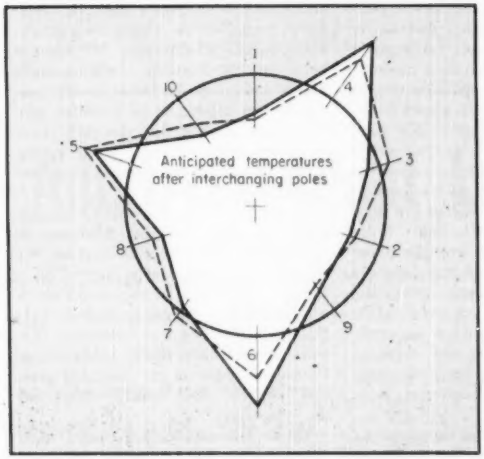
For a given diameter and temperature difference the deflection will vary about as the square of rotor length. In other words, sensitivity to thermal unbalance increases with rotor length. Thus, in electrical machines it is generally encountered in large synchronous condensers and long turbine-generators.

Salient-Pole Rotors. Thermal unbalance correction for a machine of the synchronous motor type, Fig. 1, calls for first measuring temperature at each pole. After a load has run long enough for rotor temperature to equalize (determined by observing vibration trend), shut the machine down. Measure temperatures of each rotor pole face and dovetail, at both ends of rotor, immediately after it comes to rest.

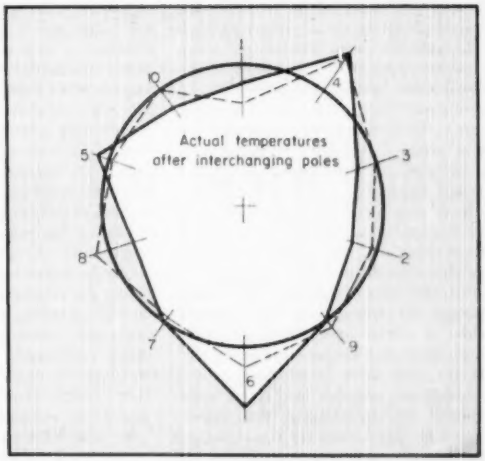
Prompt action is necessary, or the temperature gradient built up during the load run will be dissipated by conduction through rotor body. Then, too, it may be masked by natural convection cooling rotor's lower side more rapidly than upper side. Accurate measurements are essential since a temperature difference of only a few degrees will be found. For accurate results repeat the test two or more times.

Then plot results as in Fig. 2. This sketch represents actual temperatures measured on a 10-pole synchronous condenser. Tabulate difference between average temperature of each pole and mean temperature of all poles for each test run. Make separate tabulations for

...ROTOR TEMPERATURE VARIES. HERE'S SALIENT-POLE PROCEDURE

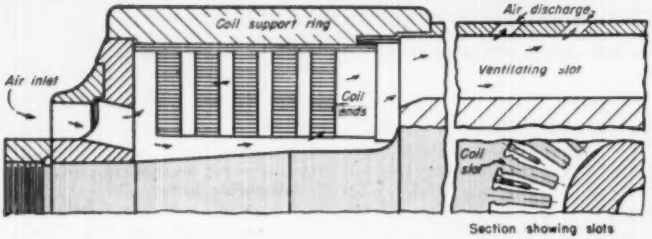


3 . . . solid lines connect pole-face temperatures. Layouts represent the average deviation from mean temperature . . .

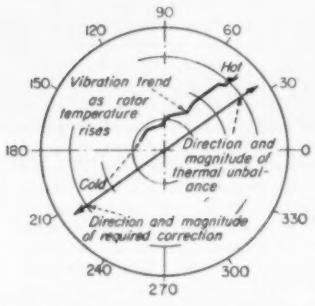


4 . . . for a synchronous condenser. Using thermocouples, two men can take complete set of readings in less than 10 min

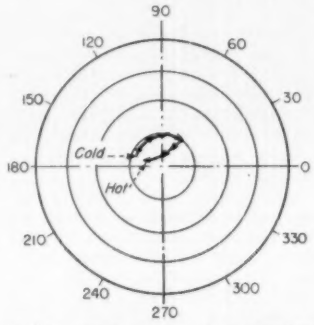
VIBRATION PATTERN FOR NONSALIENT ROTOR



5 Longitudinal and sectional views of a typical ventilating arrangement for a long turbine-generator rotor. Rotor temperature is regulated by plugging vents



6 Magnitude and direction of vibration taken at one bearing pedestal at regular intervals during warming-up period



7 This typical pattern of a transient vibration was plotted after making the necessary ventilating changes in rotor

pole face and dovetail temperatures. Then average the difference in temperature of each pole from the mean temperature for all test runs.

Draw a circle of any convenient diameter to represent mean temperature of all poles. Plot to scale the average temperature deviation of each pole from the mean temperature using mean-temperature circle as a base. You'll then have a magnified view of rotor-temperature variation. In the case shown, the hottest poles, by coincidence were grouped together. Diagram, Fig. 2, is obviously unbalanced about the circle's center.

Next step is to rearrange poles till the diagram is balanced about center of circle using the same values for average deviation from mean temperature. Check this by cutting out a cardboard polygon and pivoting it on a pin through center of circle. Several solutions may be possible, but choose the one involving the least work in changing poles. For instance, results in Fig. 3 were obtained by rearranging the values plotted in Fig. 2, whereas Fig. 4 represents actual temperatures measured by test after interchanging pole 2 with pole 4 and pole 5 with pole 9. Results were entirely satisfactory. Balance weight correction is still necessary after rearranging poles.

Turbine-Generator Rotors. An altogether different procedure is used for thermal balancing nonsalient pole rotors. In this case the temperature difference needed to cause undesirable vibration is slight. And, furthermore, access to rotor for temperature measurement is often difficult. With nonsalient pole rotors, balancing is accomplished by inserting obstructions in the rotor ventilating ducts much as you would add static balance weights. Use the vibration trend as rotor temperature changes to determine location and magnitude of thermal correction. Rotor temperature change is brought about during heat run by changing only one factor. For example, change power factor while holding load constant. Allow ample time for equilibrium to be established. Subsequent runs for checking the effect of a change in the rotor ventilating system should duplicate conditions of the initial run.

Air-Vent Blocking. Plot the vibration data as a polar diagram, Fig. 6. Center of diagram represents zero vibration. This data taken at regular time intervals, will under conditions of thermal unbalance show a definite trend as rotor temperature changes. Direction of the trend with temperature increase is the same as if weight were added to rotor's warmer side. Hence, location where rotor cooling slot should be blocked is the same as that at which weight would be added if the unbalance were purely a matter of weight correction. Magnitude of the correction must be determined by trial. Usually, after one trial correction the necessary corrective measure can be closely estimated.

Temporary blocking of discharge openings of rotor cooling slots is handled by inserting blocking strips into slots through generator air gap. While this is a painstaking, difficult operation it saves the time required to withdraw and reassemble the rotor. Rotors having a length to diameter ratio conducive to thermal unbalance sensitivity can be provided with means for partially blocking the rotor cooling slots at rotor ends.

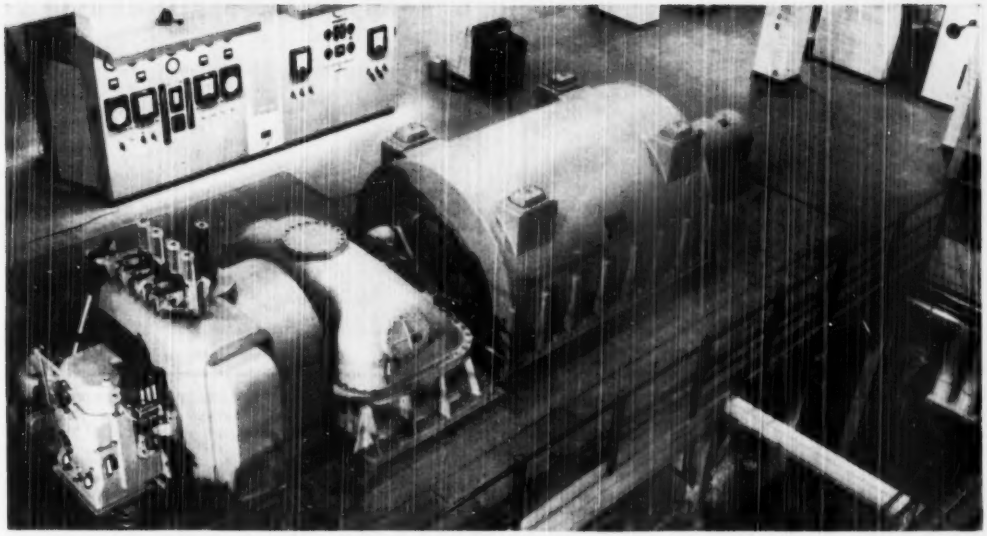
Following modification of rotor cooling system to compensate for thermal unbalance you will find vibration will usually undergo a transient variation while the rotor temperature is changing. But it will return to the original condition when the temperature becomes stable. A typical corrected transient vibration pattern is shown on Fig. 7.

Other Causes. Another factor causing the bowing of shafts and behavior similar to thermal unbalance is sometimes found in high-speed induction motors and dc machines. Such is the case where laminations are mounted directly on the shaft and clamped at the ends by a retaining plate secured to the shaft. Variation in the build-up of parts, which may arise from a slight, accumulative variation in laminations thickness, causes a difference in pressure between laminations diametrically across the rotor. Under assembly conditions the difference in pressure may not be enough to deflect the shaft much since the core will act like a spring owing to the inherent waviness of the laminations.

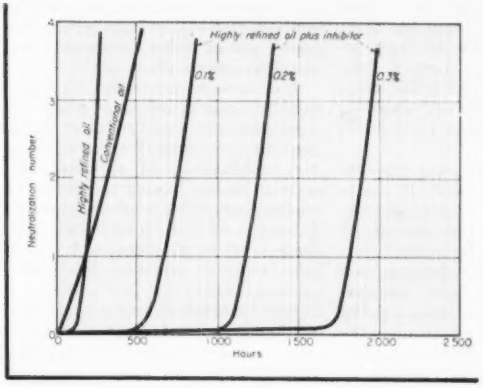
In operation the core will be warmer than the shaft and the difference in interlaminar pressure will increase, for the tight side may be compared to a spring compressed to approximately a solid condition. This may lead to shaft bowing and consequent unbalance that will increase with rotor temperature. Partial reduction in the clamping pressure on the rotor usually clears up the symptoms.

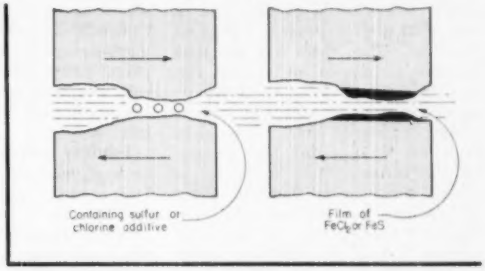
Other Equipment. Experience with operation of heated rotors in other major equipment has long shown the

(*Continued on page* 208)



TURBINE LUBRICATION along with machine design has stepped ahead with the times. Years have been added to the former life expectancy of turbine lubricating oils mainly through the aid of lube additives and improved refinery-plant practice





EXTREME-PRESSURE additives form protective surface layers of solid lube as result of high temperatures under heavy loads ←

NEUTRALIZATION-NUMBER CHANGE with time for oil samples tested by oxidation apparatus. Oxidation leaps ahead once started

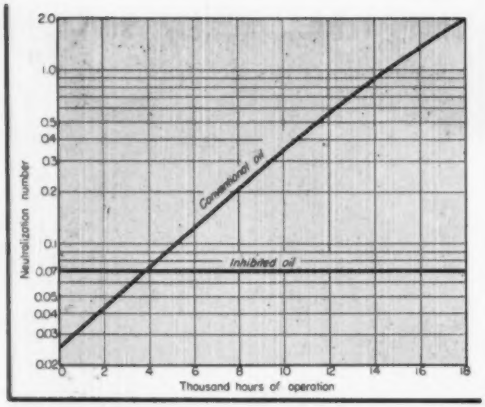
Additives Adapt Lube For More Jobs

Here's what additives are, why they are used, what they do. Some inhibitors have already become more important than the oil itself. Tomorrow additives will be used more in combination with synthetic oils

► WE HEAR A LOT about the new additive-type oils. We are almost made to believe that adding chemicals to lubricating oils is a new and revolutionary science. Actually, compounding was introduced over 75 years ago.

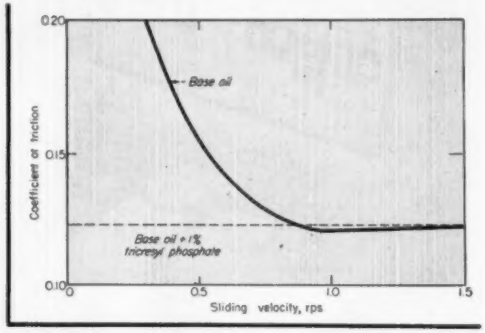
At that time, petroleum additives were eyed with suspicion since they were often used to dilute the currently accepted and more expensive animal and vegetable oils rather than to improve their quality. Modern steam-cylinder oils with their 1 to 5% compounding are one of the oldest types of additive oils.

But the commercial application of chemical additives on a large scale began about 1930. Introduction of high-compression gasoline engines put a heavy demand on lubricants. This and other developments greatly speeded the development of these chemical agents designed to improve the properties of



LIFE COMPARISON for a conventional oil and an inhibited oil. Neutralization number is one key for judging remaining life

CHARACTERISTICS MISSING IN...



LUBRICITY AGENT added to oils used under any severe rubbing conditions. Test made with ½-in. steel balls on steel plate

lube oils. Further work on improving oils through chemical additives has been intensified by the advent of higher speeds, higher-powered engines and motors.

What Additives Do. In general, lube additives are specific chemical compounds added to oil to alter one or more of its specific chemical or physical properties. Thus there are oxidation inhibitors to improve oil stability, oiliness agents to improve lubricity, extreme-pressure agents to relieve welding tendencies under heavy loads, detergents to keep dirt from depositing on surfaces, rust inhibitors to prevent corrosion by moisture. Often the additive has assumed the most important position over the petroleum product. The oil is merely a solvent for the additive.

Let us start our analysis of additives by considering rather carefully the extreme-pressure (EP) lubricants. EP lubricants fit into the picture where pressures are in the order of 142,000 psi. Under such conditions the continuous hydrodynamic or thick-film lubrication would normally be ruptured. Hence lubricants that prevent metal-to-metal contact at these high pressures include the commonly called strong EP lubricants. On the other hand, mild EP lubricants are suitable for certain industrial applications where somewhat lower pressures are involved.

Present mild EP industrial lubes have a load-carrying capacity three to ten times that of a straight mineral oil or in the order of 20,000 psi and upward. And in general the following four chemical elements (or compounds containing them) are incorporated into an EP: sulfur, lead, chlorine, phosphorus.

One large general field was developed after trouble sprung up in steelmill pinions. This has been eliminated through the use of EP lubricants. Screw-down mechanisms have also benefited. Taking a steel mill as an example, the following are several places where EP lubricants are used: Pinion-drive gears and bearings, reduction-gear mill drives, modern crane gears, pump gears, antifriction work-roll and back-up roll-neck bearings, heavy mill-table bearings, shear drives and ways, etc.

Lubricity Agents. In many types of modern machinery, lube oil meets loads, speeds and clearances that result in only a very thin film of oil between sliding metal surfaces. This film is sometimes so thin it is ruptured by high spots on the metal surfaces. This may mean pickup, wear, welding or seizing. Tendency toward wear under these conditions of boundary lubrication can frequently be overcome by the addition to the oil of chemicals that react to form solid lubricants. Hence the lubricity agent bows into the picture.

When the lube problem is not too severe, antiwear or mild additives are used. These are polar compounds such as organic phosphates, phosphites and chlorinated aromatics. These are strongly absorbed on metal surfaces to give at moderately high loads a protective lube layer of high film strength.

Oxidation. All petroleum products have limited stability. And that stability is greatly decreased by modern refining methods that tend to eliminate natural oxidation inhibitors. Such petroleum oils often give only very short useful life in equipment with acids, gum sludge and carbon formation, resulting in poor operation and premature failure.

But by adding inhibitor additives the oxidizing tendencies can often be kept to negligible value. A variety of compounds make up this additive group such as phenols, napthols, aromatic amines, sulfur compounds and selenium compounds.

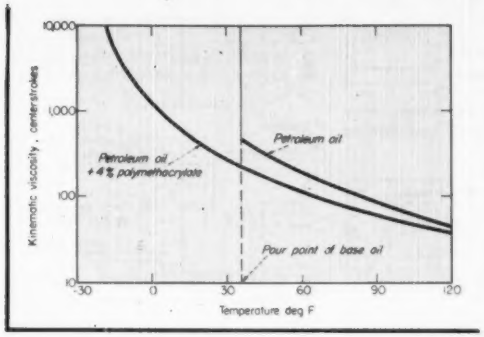
It's through the effect of these inhibitors that present-day turbine oils have their life extended many years. But keep in mind that occasionally the inhibitor may be chemically destroyed by the bearing metals or by contaminants in the lubricating system. Even the oil filter may be at fault. Some types of oil filters will remove some types of inhibitors leaving the oil unprotected.

Rust Inhibitors. Of major importance among the lube additives in the electrical industry are rust inhibitors. The steam-turbine oils saw an early application of this type additive. When a rust-inhibiting oil is applied, a layer of the rust-preventive molecules adheres to the vulnerable surface, thus keeping water away.

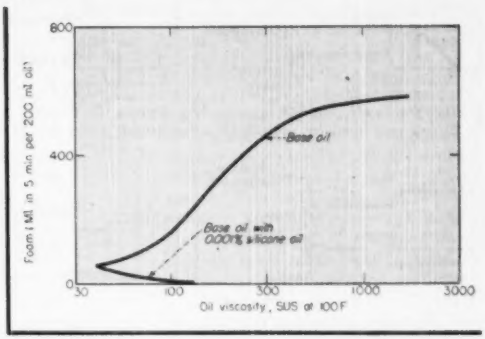
Still other rust preventives act as emulsifiers. These enable the oil to take up small amounts of water from the metal surface before it has a chance to start rusting. The oil then surrounds the water and holds it as droplets in suspension in the oil where it can cause no trouble.

Indiscriminate use of rust inhibitors may, however, be harmful since many deteriorate rapidly at high temperatures. And some promote corrosion where dissimilar metals are in contact. Still others cause accelerated oxidation of the oil. And even the

...PETROLEUM PRODUCTS ARE SUPPLIED BY SYNTHETIC INHIBITORS



VISCOSITY-TEMPERATURE characteristics, and consequently the viscosity index, improved with addition of polymer additive



FOAMING with and without silicone defoaming agent. Silicone weakens surface film around the foam bubble till it breaks

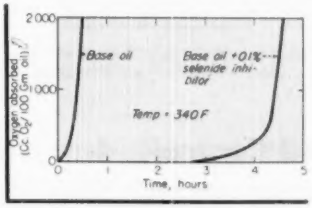
best bleed away in time from the metal surface under continued water attacks, leaving it unprotected.

V-I Improvers. Some years back a number of chemical compounds were developed to extend the lower limits to which petroleum lubricants could be used. Similar additives were found to give an improved viscosity index, hence a more constant viscosity with changing temperature.

The best of the pour-point depressants are polybutenes, polymethacrylates, and alkylated polystyrenes. Although the exact way that these additives act is not known, they are believed to lower the pour point by preventing the formation, on cooling, of a lattice-like crystal structure. This lattice normally acts as a trap, preventing the oil from flowing or pouring. Many fine products have been produced with these additives. As little as 0.5 weight percent can be used to lower the pour point of some oils as much as 50-60 F. And a few percent will give oils with viscosity indexes of 150 to 160. These values are not obtainable otherwise with petroleum oils.

Detergent Additives. Oil should lubricate efficiently even in the presence of obnoxious materials. This requirement holds especially for diesel and gasoline engines since carbon deposits are detrimental. Hence the addition of certain detergent or cleaning agents is now accepted.

Lubricating oils must also be suited to the atmosphere under which they must lubricate. Thus in steam-cylinder lubrication, pure mineral oils are usually unsuited because of their inability to coat metal surfaces in contact with water or steam. This metal-



OXIDATION INHIBITOR effectively delays the start of lubricating-oil breakdown

surface wetting is handled by compounding. This, too, will aid emulsification and spread the oil over large areas. Steam-cylinder lubricants are generally residual, heavy-bodied mineral oils, filtered or nonfiltered. They contain one or more of the following compounding agents depending on the steam temperatures and pressures.

1. Nondrying fatty oils are used such as acidless tallow oils, degras oil, neat's-foot oil, rosin oil, etc.

2. Colloidal graphite is also used to some extent for steam cylinder lubrication, in either the form of oil or water suspensions. The former method is used for superheated or saturated steam and the latter for saturated steam only.

Defoaming Agents. Oil foaming has been a problem in turbine lubrication. You can see how this is a trouble source if enough foam forms so the circulating pump delivers only a supply of bubbles. Insufficient lubrication will result and possible bearing failure. Foaming may also cause overflow from the oil reservoir. Detergent-type oils have greatly increased foaming tendency compared to regular petroleum oils.

Settling pans, baffles and filter beds have been used to break up the air bubbles. But the silicone oils have been found quite suitable as additives for dissipating foam. In all probability the low surface tension of the silicones causes the surface film around the foam bubbles to weaken and thus rupture easily. This action has been compared to that of a pin pricking a toy balloon.

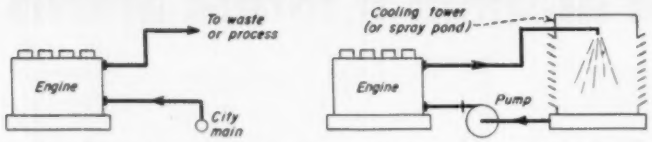
In addition to the foregoing additives, many more are finding considerable application. For instance, tackiness agents are used in some machinery applications to make lubricants sticky so they will stay in place better. Metal deactivators reduce the accelerating effect of metal surfaces on lubrication oxidation. Then anticorrosion agents reduce the corrosive attack of oil-oxidation products on metal surfaces.

It goes without saying that lubrication additives, being relatively new products, will probably be greatly improved in future years. Looking back over the years, their development has progressed so rapidly that some have already become more important constituents of the lubrication than the oil itself.

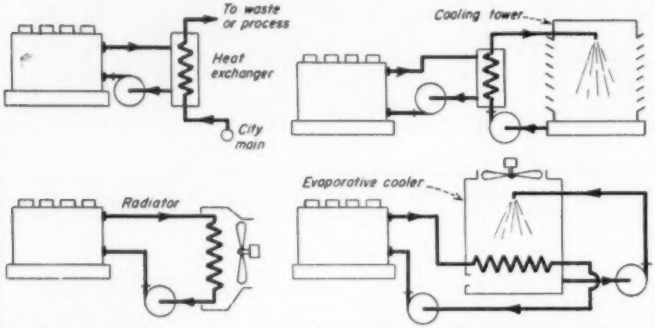
Then again certain properties of petroleum oils make them rather limited in usefulness in this role of a carrier. Hence additives of the future will most likely be used more and more in combination with the new synthetic oils. Some of these are the ester, polyglycol and silicones.

Based on data from ASLE paper, "Extreme-Pressure Lubricants. Their Development and Utility in Industrial Lubrication"; American Cyanamid Co's "Chemical Additives for Petroleum Lubricants," and E. K. Bosser's "Additives for Lubricating Oils."

CLOSED SYSTEMS AVOID OPEN-SYSTEM FAULTS

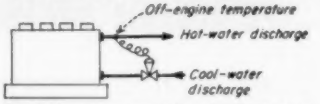


1 Elementary diagrams of open cooling systems: Continuous addition of fresh water in one and need for makeup in other (*right*) bring danger of scale and deposits

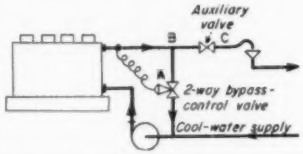


2 Four typical closed cooling systems in elementary form: Note that in all cases jacket water recirculates in a completely closed circuit without contamination

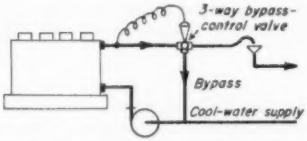
POINTERS ON BYPASSES...



3 Without bypass, inlet temperature is fixed by that of the supply source



4 Bypass blends warm water with cooler supply, holds temperature rise lower



5 Use of 3-way valve assures positive control; no auxiliary valve is needed

Diesel Instruments and Controls: 4

By **EDGAR J KATES**
Consulting Engineer, New York, N. Y.

20 Pointers on Cooling-System Layout

► WHEN IT COMES to keeping tabs on engine-cooling systems, we have at hand a wide variety of instruments and control devices, as our previous article (Oct. pp 92-96) revealed. The real trick lies in putting them to work in ways that get best results. That means knowing something about cooling-system layout as well as about instruments and controls. Here are 20 practical points to watch in your planning:

1 Ample cooling comes first under all conditions.

This means more than spare pumps or emergency overhead tanks for continuous flow, and controls to hold temperature at right level. It also means heat recovery must take second place to engine cooling. Such systems must be controlled so engine jackets *always* receive enough water, at right temperature, *regardless* of heat demands.

2 Closed cooling systems avoid faults of open systems.

In an *open system*, water leaving engine jackets is either not returned at all or is recirculated after exposure to air. Fig. 1 shows elementary open systems. Note that the cooling-tower or spray-pond hookup, although sometimes called *a* closed *circuit* because water is recirculated, is an open *system* because water is exposed to air.

Water impurities, and the danger of scale and sediment deposits in engine jackets, constitute a problem in open systems. If water is not returned to engine, new water continually brings in foreign matter; if water is recirculated, through tower or pond, evaporation and drift (0.5 to 1 gal per bhphr) require makeup, which brings in impurities. Since evaporation and drift don't take away any impurities, they concentrate continuously. If system isn't blown down regularly, more scale and deposits may result than if water isn't returned at all. Open systems may be used, however, where water supply is ample and exceptionally pure.

Closed systems recirculate jacket water through closed heat exchangers. Thus the same water remains in the system indefinitely and is recooled without exposure to air. If it is pure at start it stays pure. Heat exchanger may be *water-to-water* (shell-and-tube type) or *water-to-air* (radiators and evaporative coolers). Fig. 2 shows some elementary closed cooling systems.

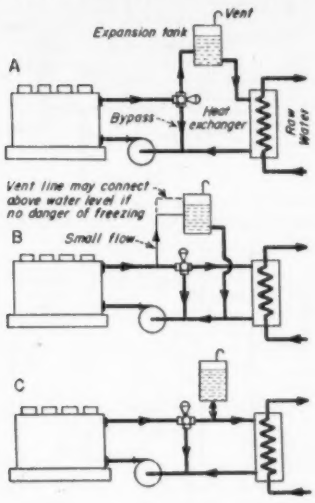
With water-to-water heat exchangers, secondary or "raw" water may pass through only once if supply is ample and there is no need to conserve it. Water use may be cut 90-95% by recirculating after it is cooled in a tower or spray pond. Only loss is evaporation and drift.

An evaporative cooler is, in a sense, a combination of a water-to-water exchanger and a cooling tower. Jacket water flows through coils while raw water is sprayed over them. Air blown over coils evaporates raw water on their surface, thus cooling water within.

Closed systems are particularly desirable where heat is to be recovered. The job may be done by transferring *heat* and not the hot water itself.

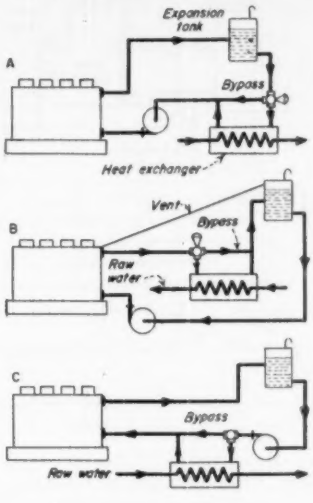
Regardless of water purity, a closed system with a heat exchanger must be used where the cooling tower is so high above the engine, or so far from it, that necessary head would put too much pressure on jacket seals. In tall buildings, for example, engine is in base-

...ON EXPANSION TANKS...



6 Flow through expansion tank (*A* and *B*) aids in venting, prevents a freezeup

AND ON HEAT EXCHANGERS



7 Bypassing the heat exchanger instead of the engine is often preferable

No matter how good its controls, no cooling system is better than its basic hookup. When you start to plan your new system or improve your old one, keep your eye on the angles summarized for you here. They're distilled from long experience

ment and tower on roof. With heat exchanger in basement, engine jacket system runs at ordinary pressures. Pumps for the secondary system to the roof are subjected to high static pressure but dynamic head is much less because of high suction head.

3 It's better to regulate engine cooling by controlling temperature of water entering jackets than by regulating flow rate.

Don't be confused because a temperature-actuated valve is used in both cases. The distinction is really between hookups for direct flow through the engine and hookups using bypasses. With direct flow, Fig. 3, control valve changes flow rate through jackets as load varies on engine. This has several disadvantages: Incoming water temperature is fixed by nature of source, and is usually lower than desired. River water, for example, rarely runs higher than 80 F, even in summer. With off-engine temperature controlled at level specified by engine builder, say 160 F, temperature rise is 80 F. This is much higher than the 10-15 F recommended for best results. Thus we must expect more heat distortion in cylinders. Also, at low engine loads, flow rate is small and velocity low. This may permit vapor pockets and hot spots to form.

In a bypass hookup, Fig. 4, part of hot water off engine blends with incoming cool water. Thus inlet temperature is independent of water source and can be high enough to insure a small temperature rise through jackets. Flow rate is always high so a high off-engine temperature can be used safely.

4 Three-way bypass valves are more positive than 2-way valves.

Fig. 4 uses a 2-way bypass valve, *A*. Water at point *B* has a choice of two paths: to funnel or to bypass valve. Line to funnel offers little resistence; hence bypass valve may lose control because most of water flows to funnel even if bypass valve is wide open. This can be cured by adding auxiliary valve *C*. This increases pressure at *B*, causing greater flow through bypass.

On the other hand, 3-way valve of Fig. 5 needs no auxiliary valve. It opens one path while closing the other, thus compelling flow in the wanted direction, regardless of relative resistances.

5 Use ample expansion tanks or surge tanks in all closed systems.

Capacity should be enough to take care of volume changes caused by temperature, keeping jacket system always full. Place tank so bottom is above engine top. Then engine jackets will be full even when tank is almost empty. This may also permit tank to serve as emergency water supply under gravity head (for a short time).

Make sure water level is kept. If tank is in view of operator, an ordinary gage glass does the trick; otherwise, use some form of level indicator. Safe water level is sometimes assured by a float valve set to admit makeup if water level falls below danger point. Check such a valve regularly; if there's a leak in the system, water flows in continuously and overflows.

It's better for some or all circulating water to flow through the expansion tank, Fig. 6*A* and *B*, than to deadend as in *C*. This gives better venting, prevents freezeups.

Arrangement of Fig. 6*B* sometimes fits in better than *A* because expansion tank feeds *directly* to pump suction, and can be placed lower while still giving the same head on the pump. Fig. 6*B* also uses a smaller pipe to the expansion tank. If there is no danger of freezing, vent line may enter expansion tank above highest water level, thus making air discharge easier.

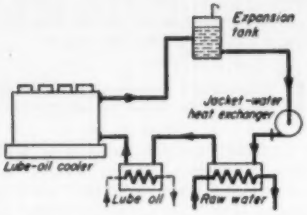
It's best to close expansion tanks. This reduces contamination and evaporation. Provide a vent pipe to give free discharge to air and gases.

When a large quantity of water is stored, a hotwell at ground level is sometimes used. This may be less costly than a large overhead tank. With a hotwell, put in a small overhead tank to insure head of water at top of system and provide venting.

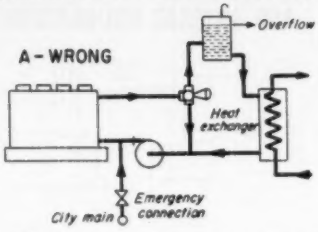
6 Consider possibility of putting bypass across heat exchanger instead of across engine.

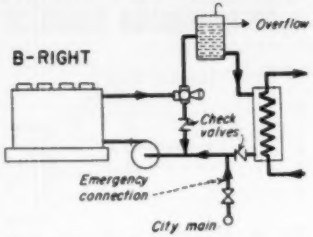
Preceding diagrams have shown the regulating bypass across the engine. Another scheme, sometimes preferred, is to bypass the heat exchanger, as in Fig. 7. Where pump is integral with engine, *A* and *B* may be used. In *A*, the heat exchanger is on suction side; in *B* it's on discharge side. Pump receives water direct from expansion tank but engine jackets are subjected to additional pressure because of pressure drop in heat exchanger. Bypass valve should be 3-way type to force flow through

TIPS ON OIL-COOLER HOOKUPS, EMERGENCY CONNECTIONS, ADDING TREATING CHEMICALS

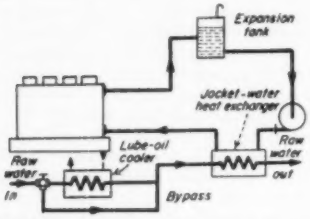


8 With oil cooler in the jacket-water circuit, temperature control is good

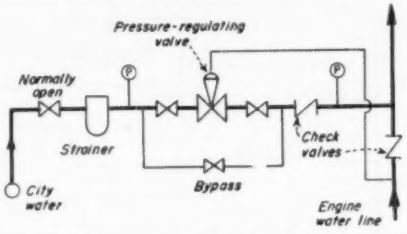




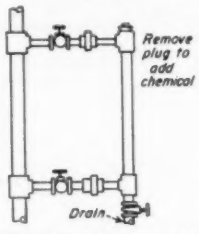
10 Emergency cold-water connection should never be made close to engine, as *A*. Connection in *B* gives water a chance to get tempered before entering the engine



9 When oil cooler is in raw-water circuit, a bypass prevents overcooling



11 Piping connections for automatically turning on emergency water supply that is under pressure



12 Trap facilitates adding water treatment

bypass despite low pressure drop through heat exchanger.

In Fig. 7*C*, a common arrangement with motor-driven pumps, heat exchanger is on pump's discharge side, and heat exchanger can be designed for greater pressure drop without putting greater pressure on engine jackets. Arrangement in 7*C* is also used with evaporative coolers, jacket-water coil taking place of heat exchanger. Another way to bypass an evaporative cooler is to control air flow by ducts and dampers. This may be automatic.

7 Provide means for thorough venting of air from the system.

It's practically impossible to keep air out of a cooling system. It may come in dissolved in makeup water, it may be picked up in open cooling systems, or it may leak in through pump stuffing boxes. City water is often highly aerated; dissolved air is freed when water is heated in the jackets.

Where water flows continuously upward, air can be freed in a vent tank at top of system. If piping must be looped, use automatic air-release or vent valves at tops of all loops.

8 Provide drains wherever necessary to permit working on engine or piping and to prevent freezing.

9 Install heat exchanger to permit easy cleaning.

In shell-and-tube heat exchangers, jacket water should flow in shell, around tubes, raw water through tubes. Raw-water side needs cleaning oftener than jacket-water side, and it's easier to clean inside of tubes than outside. For same reason, heat-exchanger design should permit cleaning inside of tubes without disturbing raw-water connections. For greatest efficiency, pipe heat exchangers for counter flow.

10 In piping pumps, keep a careful eye on suction-head conditions and on jacket pressure.

Suction head on centrifugal pumps should be positive enough to prevent vapor binding when water is at maximum temperature.

Small and medium-sized engines often have geared or belted pumps discharging directly to engine-jacket inlet, Fig. 6. This setup sometimes has the disadvantage of putting too much pressure on engine jackets because pump discharge head must overcome friction loss not only in engine jackets but also in rest of system, and this full head is placed on the engine jackets.

Motor-driven pumps give freedom of location and piping arrangement. Fig. 8 shows an elementary hookup for minimum pressure on engine jackets when an oil cooler as well as a jacket-water heat exchanger is included in the circuit.

Water cores of ordinary radiators are designed to withstand only relatively low pressures and to operate with low friction loss. Thus it's usual practice to connect the radiator on engine's discharge side.

11 Should lube-oil cooler be in jacket or raw-water system?

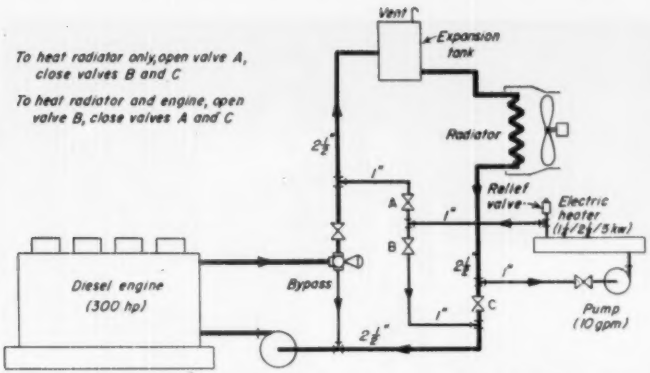
If in jacket system, Fig. 8, water side needs little cleaning. Also, oil temperature and jacket-water temperature tend to rise and fall together. Thus if jacket temperature is under automatic control, oil gets the benefit. This is particularly advantageous if oil is chilled when engine starts; rapid warming of jacket water *heats* lube oil quickly to proper working temperature. But at load conditions, oil cannot be cooled below jacket-water temperature. Also, a larger heat exchanger is needed for the jacket water so it can absorb heat of the oil.

If lube-oil temperature must be kept low, put oil cooler in raw-water side ahead of heat exchanger as in Fig. 9. This hookup requires a bypass around oil cooler to prevent over-cooling lube oil when water is cold and load is light, also when starting cold.

12 Give careful thought to relative merits of common and individual cooling systems for multiple-engine plants.

A common cooling system needs only one set of pumps, heat exchangers, etc, connected to manifolds serving all engines. Thus it uses fewer pieces of equipment, takes less investment. Individual systems make each engine in-

ELECTRIC HEATER PROTECTS AGAINST FREEZEUP HAZARD



13 Electric heaters with small pumps to circulate water are effective in preventing freezeups. Diagram shows piping of typical installation in New York City

dependent, permit more accurate control, increase reliability, avoid long runs of large manifolds. They are thus coming into frequent use in big plants.

13 Cold-water connections for supplementary or emergency use in recirculating systems should never enter piping near engine.

With a hookup like Fig. 10*A*, sudden drop in water temperature shrinks engine liners, may cause piston seizure. This is particularly likely if emergency supply is turned on after regular water system has failed and engine overheated. So locate cold-water connections far enough from engine inlet to temper *initial* water before it enters engine, Fig. 10*B*. Be sure to provide necessary check valves to direct flow if pump is not working, also adequate overflow or pressure relief.

If city water or other pressure source is available, it's easy to turn on emergency supply automatically if regular system fails. Fig. 11 shows an automatic pressure-regulating valve which opens when system pressure falls below a predetermined point.

14 Locate water connections to natural sources (lakes, streams, etc) according to common-sense principles.

Avoid short circuiting. In a flowing stream, locate water intake upstream from the outlet. In a still body of water, separate intake and outlet sufficiently. Usually intake should be farther off shore than outlet. This provides cooler water from a lower level. Outlet should be near surface so warm water spreads on surface and gets a chance to cool by evaporation. There is also less effect on intake water.

15 Usually little is gained by reducing flow of raw water when engine load is light, or raw water is colder than usual.

This generally makes control of raw-water circulation quite simple. Bypass control on engine-jacket system keeps jackets at proper temperature even if there is a raw-water surplus. If pump layout is such that pump power can be reduced by reducing flow, manual flow control is adequate.

Exceptions to above occur when (1) raw water is costly (2) discharged raw water is wanted at constant temperature, as for heat recovery. Here thermostatic valves are used, generally controlled by temperature of raw water itself, *not* by engine-jacket temperature. But here special provision must be made to keep engine cool when heat-recovery demand falls off.

16 Watch local ordinances when planning interconnections between water mains and sewers.

For sanitary reasons, ordinances usually forbid any direct connection between a city-water main and a sewer. If city water is to be connected directly into an engine-cooling system, the discharge may be carried to the sewer only through an open sink or through an approved type of nonreturn valve.

17 Provide bypasses around important automatic valves.

Bypasses, like the one around the pressure-regulating valve in Fig. 11, permit maintaining flow and control even if valves get out of order or are removed for maintenance. For simplicity and clarity, diagrams in later articles will not show bypasses—assume them.

18 Make cooling-water treatment easy, even on closed systems.

There is little likelihood of scale formation in closed cooling systems because only a limited amount of mineral impurities is contained in water used to fill system the first time. It is good practice, however, occasionally to add a chemical treatment to inhibit corrosion. A simple way to introduce such chemicals into a completely closed piping system is to use a trap like that in Fig. 12. Fill it with water before closing, to prevent air entering the system.

19 In cold regions, provide safeguards against overcooling and freezing.

Cooling towers should have secondary inlets at a lower level so falling water is exposed a shorter time. Never use a bypass around a cooling tower if temperature can be freezing; reduced water quantity freezes faster.

Provide evaporative coolers with shut-off dampers, or better, with bypass dampers to reduce cooling effect of air. Radiators, likewise, should have dampers. Variable fan speed is also helpful in reducing cooling effect.

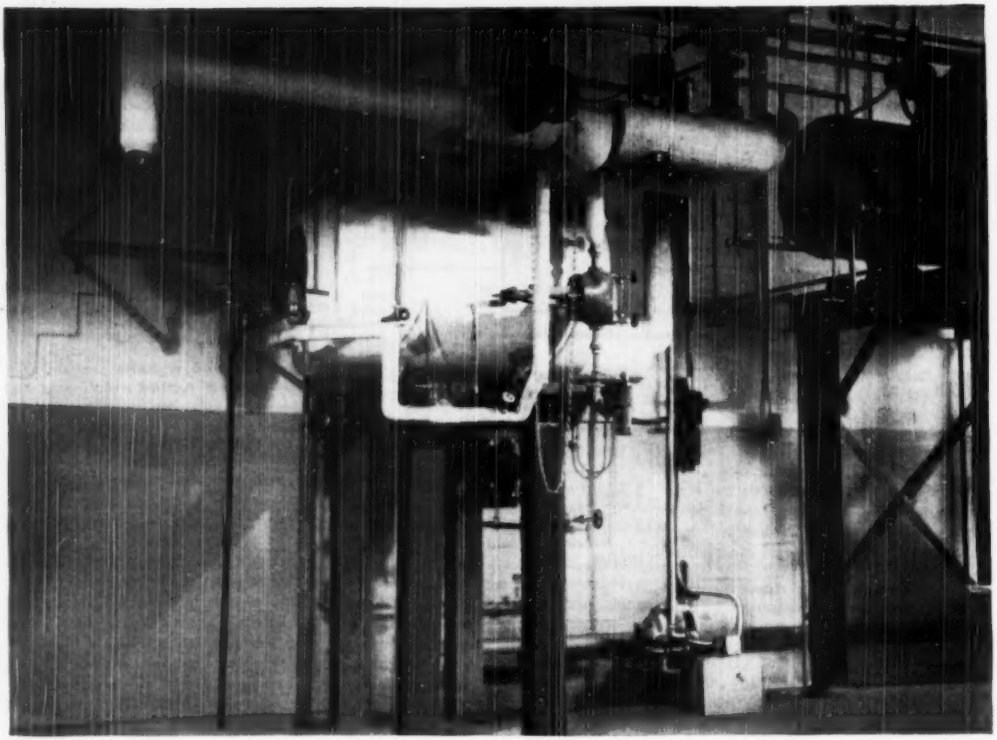
Expansion tanks will not freeze during operation if warm jacket water is circulated through them.

When cooling systems are shut down in cold weather additional precautions are needed. Antifreezes are effective but apt to be expensive, particularly if the charge is lost by accident. Another disadvantage is that engine must start on extremely cold water.

Freezeups can be prevented by completely draining the system. This not only wastes water but may also prove a nuisance when the system is refilled because of the time needed for the job and of air pockets that usually form. *Always wait until engine has been shut down long enough to give off residual heat before draining!*

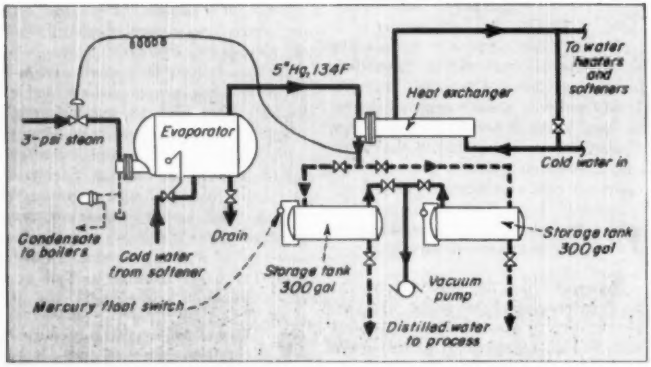
Electric heaters with small pumps to circulate water are convenient and effective. They are particularly well adapted to closed systems with exposed water-to-air radiators where a freezeup would do expensive damage. Such units cost little to install and operate. Not only do they prevent freezeups; they improve engine starting because jackets are supplied with warm water. A typical layout, used satisfactorily in New York City's climate, appears in Fig. 13.

20 Locate important valves where they are easy to get at for inspection and maintenance. Label them to correspond with a complete reference diagram.



EVAPORATOR receives water from softener, flow being controlled by a float valve. After steam from evaporator is condensed, it is stored in the distilled water tanks, *upper right*. Distilled-water temperature and level control heating-steam flow

Cures Heater Troubles, Saves Money



DISTILLATION, HEATING EQUIPMENT in new plant. Return of evaporator condensate to boiler, use of distillate vapor to heat process water gives economical balance

E H Roper, Toledo, tells how he stopped corrosion in water tanks, overheating of water heaters and scaling of boilers in an industrial process plant

► WATER-HEATING EQUIPMENT that scales up and overheats can give you plenty of trouble. Besides, it costs a nice bit of cash. That's what was happening in an old plant when I was called in to make suggestions for improving output. To see how we tackled and licked this job, let's first take a look at the old

WATER-HEATING AND DISTILLING EQUIPMENT FOR PROCESS WORK

Heat Exchangers

Instantaneous heaters	
With copper heads and tube sheets	Alberger Heater Co
Copper-lined	Sims Co
Evaporator	Davis Engineering Corp
Condenser	Davis Engineering Corp

Controls

Temperature regulators	Powers Regulator Co
Float switches	Mercoid Corp
Vacuum switches	Mercoid Corp
Solenoid valve; water supply to vacuum pump	Mercoid Corp
Float-operated valve	Davis Regulator Co

Miscellaneous

Pressure-relief valves	Watts Regulator Co
Copper water-storage tanks, 2	Gernstein & Cooper
Vacuum pump	Nash Engineering Co
Float and thermostatic traps	Warren Webster & Co

plant and the troubles caused by improper heating of process water.

Old Plant. Large quantities of hot city water, hot deionized and softened water, and distilled water were used in process work. Water was heated in gas-fired steel tanks fitted with internal flues. Heavy scale deposits on tank interior caused localized overheating and failures. Maintenance was excessive. We also found that tanks for heating deionized water corroded rapidly because pH of water was low.

The old plant had a distilling outfit consisting of a copper coil submerged in a tank fed with city water. Low-pressure steam from the heating system flowed through the coil and condensed after heating the water. Distilled water produced equaled makeup water required for locomotive-type boilers.

Boilers scaled badly and with the help available it was impracticable to soften and blowdown solids left in them. This scale damaged all boilers; one was replaced before the new plant was built. Corrosion throughout the return system was also a headache. These were the big problems we had to crack while planning the new setup.

New Plant. All deionized and softened water could be warmed to 90 F before softening without harm to softener. Since most of this water was heated to 160 F or higher after softening, any heat we could add before softening represented a net gain. In addition, a large quantity of water was heated and used without softening.

Ratio between distilled-water usage and water for all other services remained fairly constant. Distilled water could be used at 160 F and below.

Since we had low-pressure steam available at all times at a cost lower than gas we decided to use steam as the heating medium in our new water heaters. Instantaneous heaters were installed for the various temperatures of water needed and for the different kinds of water used. Heaters were copper-lined, or made with copper shells and tube sheets to withstand the corrosive action of the water.

After studying the heat balance we came up with the layout shown on facing page. Water from the softener flows to the evaporator, flow rate being controlled by a float valve actuated by evaporator water level. Low-pressure steam flowing through a copper coil vaporizes evaporator water. Vapor from evaporator discharges to a condenser cooled by city water on its way to the softeners and raw-water heaters. The condensate, now distilled water, flows by gravity to either of two copper storage tanks. Process units are fed by gravity from these tanks.

To keep distilled-water temperature at 160 F and obtain a balance between cooling water available and distilled-water demand, we used a vacuum pump. This wet-type pump maintains a 5-in. Hg abs pressure in both storage tanks.

Temperature of distilled water entering storage tanks is limited to 180 F by a regulator, which throttles steam to the heating coil in the evaporator.

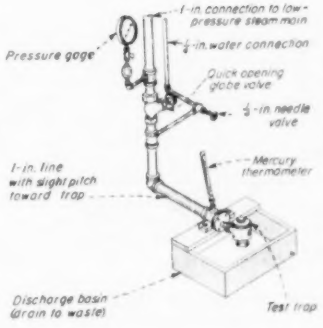
Steam flow to evaporator is also controlled by water level in storage tanks. Float-operated switches on each tank act through a solenoid valve to shut off air supply to the steam-regulating valve. When this valve is closed evaporator stops generating distillate.

To protect softening equipment against high temperatures, which might occur during low flows of cooling water, a thermostatic valve with integral by-pass was provided. This valve opens and discharges water to waste if temperatures reach too high a level.

We hooked up the distilled-water tanks so they can be alternated in service. During plant shutdowns, evaporator is drained and accumulated solids discharged to sewer.

As the plant is now laid out, all steam from the boilers is condensed and returned to them. Practically all the heat needed for distillation is recovered. No cooling water is required and we have experienced no operating difficulties since installing the new equipment. One man can run this system and still have time to look after the softener and other equipment.

HOW TO MAKE TEST STAND FOR RADIATOR TRAP

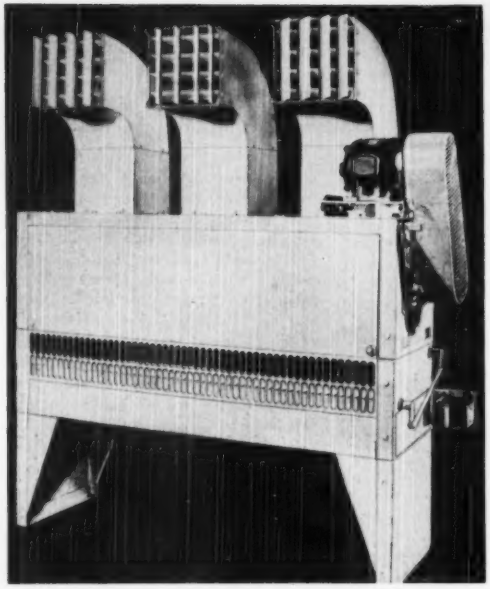


Handy radiator-trap test stand can be made from scrap or purchased parts. Bulletins C-34 and R-44, Barnes & Jones Inc, Boston, Mass., describe use.

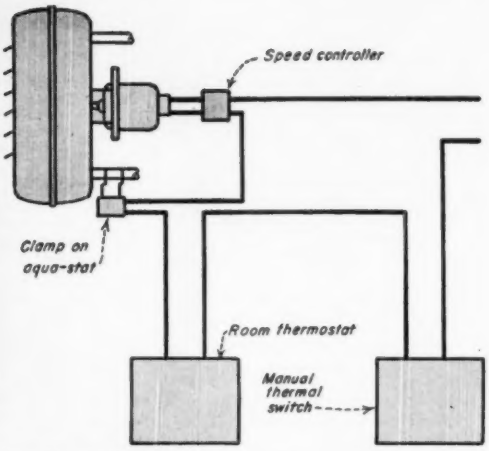
All you need are 1-in. steam and ¼-in. water connections and valves, pressure gage, thermometer and trap body.

Screw element to be tested into trap body on stand, turn on 1- to 2-psi steam. Good elements do not discharge steam. If good, crack water valve. Trap should discharge condensate at about 10 F below steam temperature. With 2-psi steam, 218 F, good elements discharge at 208 to 210 F.

PROPER CONTROL SELECTION...

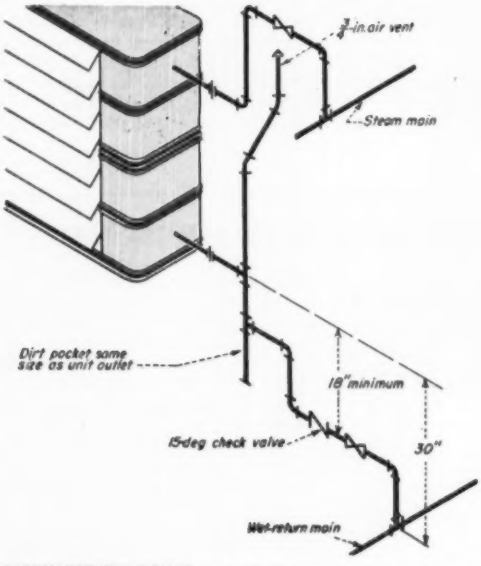


HIGH-CAPACITY UNIT HEATER, centrifugal-fan type, has float or bucket traps. Trap rating is greater than condensate flow

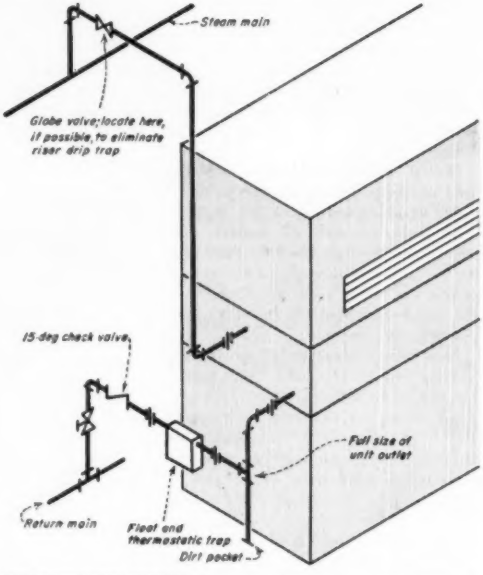


THE ON-OFF SYSTEM with thermostat starting and stopping of fan is the simplest and perhaps commonest unit-heater control

LOW-PRESSURE SYSTEM MAY HAVE EITHER CLOSED OR OPEN RETURN

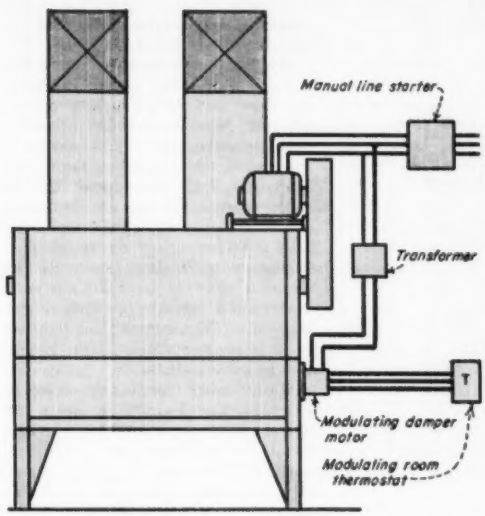


CLOSED-RETURN PIPING puts all elements at boiler pressure. Have condensate outlet at least 30 in. above boiler water line

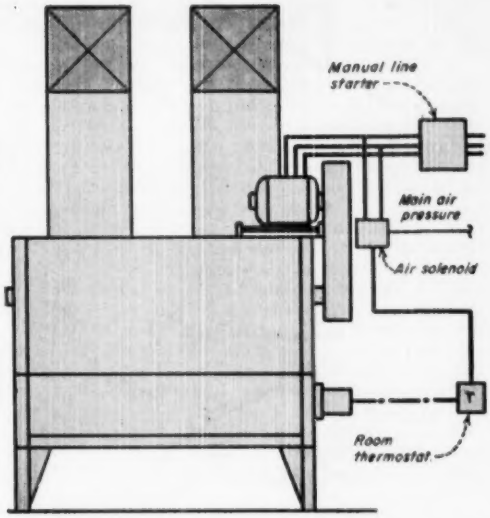

Steam main
Globe valve; locate here, if possible, to eliminate riser drip trap
15-deg check valve
Full size of unit outlet
Return main
Float and thermostatic trap
Dirt pocket

OPEN-GRAVITY PIPING returns condensate to sump vented to atmosphere. Steam-throttling control will work with this system

...DETERMINES COMFORT, AND OFTEN DECIDES FINAL PIPING DETAILS



MODULATING CONTROL parallels heater output to space needs; reduces cycling that is so objectionable with on-off system



PNEUMATIC OPERATION of face and bypass dampers gives low-cost modulating control especially if compressed air is handy

Piping and Controls Help Unit Heater Performance

You can't rest on your oars even though you have picked the ideal unit heater for the job. Here's how you can select the right piping and controls to give you top heater performance

By J H CARPENTER, *Manager, Engineering Training, Carrier Corp*

► Success of any heating installation requires more skill than just the selection of proper heat-releasing equipment (Power, October, p 82). Performance of heating equipment is directly related to the piping design and control method. Further, both occupant comfort and economical operation depend on the choice of control.

Controls should get first consideration because the method selected frequently affects the detail of the piping system. And this holds particularly for unit heaters. Two types of control that can be used for unit heaters are on-off and modulating.

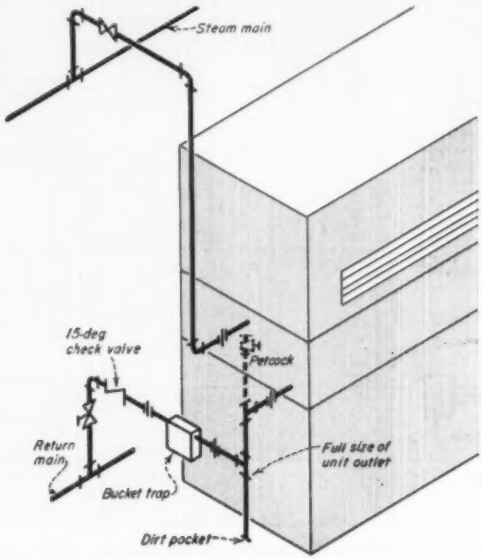
Simplest of the two and perhaps most commonly used is the on-off system, which consists of starting and stopping the fan motor at the dictates of a room thermostat. This method applies best to propeller-type units for the motors are usually small, seldom exceed ½ hp in the largest unit sizes. Several control manufacturers offer a heavy-duty thermostat designed to carry the running current of the fan motor without auxiliary devices. Thermostats of this type are usually rated to carry ¾ to 1 hp at 115 v, ac.

When this control method is applied to motors larger than thermostat rating, it is common practice to employ a low-voltage thermostat and a magnetic contactor of correct capacity.

The simple on-off control type may be made more elaborate by installing in series with the room thermostat a clamp-on type aquastat. It attaches to the return piping and stops the unit fan if the steam supply fails. If steam pressure is low, the device serves as a low-limit control and prevents the unit from blowing cold air. It also shuts down the unit in the event of trap failure.

With the modulating system, fans operate continuously and output of the unit can be varied with load by modulat-

HIGH-PRESSURE SYSTEM USES RETURN PUMP



SYSTEMS OPERATING above 15 psi classed as high presssure. Open-gravity piping, with vented sump, pumps condensate back

ing the coil face and bypass dampers. Modulating control may be accomplished with either pneumatic or electric devices. Pneumatic control often proves less costly, particularly when compressed air is available. Diagrams of p 96 and 97 illustrate schematically the control systems described above.

In general, modulating control is preferable to the on-off type since the thermostat in connection with the damper motor adjusts unit output to parallel heating requirements. On a mild day, for instance, required output might be only 10-15% of its maximum capacity and room temperature would be controlled to the thermostat setting. In contrast, with the on-off system the unit supplies 100% capacity until the heater has brought the space up to temperature and then shut down. Result is that on a mild day the unit cycles frequently. There is a second disadvantage when the fans are inoperative. Then the air in the space immediately stratifies and floors become cold.

A few general recommendations apply regardless of the control type selected: (1) Thermostats should be carefully located. Preferred spots are on interior partitions or columns. Usual mounting height is from 4 ft 6 in. to 5 ft above the floor. (2) Thermostats should not be mounted on exterior walls or in direct discharge of the unit. But should this be necessary, the controls can be compensated by lower setting. An approved and properly selected thermal protective device should safeguard all unit fan motors. Normally fuses will not protect the motor unless of special design.

Piping System. Before describing and suggesting various piping systems, let's review a few general points:

1. Coils in unit heaters are assembled with proper *pitch* for condensate removal. Because of this feature, unit should be installed in a level position.

2. Steam mains should not be dripped through the unit coil.

3. Provide each coil with a separate trap. If the unit has two or more coils use a properly sized trap for each coil.

4. For check valves, select the horizontal 15-deg swing check. A head of 5 to 6 in. of water is necessary to open a check valve of this type. So install the check at least 6 in. below the unit outlet to insure proper action and coil drainage.

5. Float or bucket-type traps are usually selected for unit-heater applications where high capacities are required.

6. All steam connections should be supported and anchored independently of the unit.

7. Install all steam mains and branches with adequate provision for expansion.

There are many steam-distribution systems. Here are the commonest described and illustrated:

Low Pressure—Closed Return. (p 96) A steam-distributing system operating at 15 psi or less is classified as low pressure. Most low-pressure closed-return systems operate at pressures ranging from ½ to 5 psig. Since the system is closed all its elements operate at boiler pressure. Return of condensate to the boiler is caused by the static head of water above the water line. Condensate traps are not normally employed in this type system. Air is vented from the system by thermostatic vent valves. These should be designed to close against water should it rise into the valve body.

Always locate condensate outlet of unit heaters at least 30 in. above the boiler water line to insure condensate return. But don't apply steam throttling control to this type of piping system because pressure reduces in the steam coil as the valve closes and water backs up from the boiler, or accumulates in the coil as steam condenses. Separate returns from each unit must be carried to a wet return below boiler water line.

Low Pressure—Open Gravity Return. (p 96) As the name implies this system operates at pressures below 15 psig. Usual operating pressure with unit heaters is about 5 psig. Condensate flow is in the return piping by gravity to a sump or receiver vented to the atmosphere. Then condensate is returned to the boiler through a boiler return trap or by a pump.

Thermostatic or float traps permit condensate to leave the unit, but prevent flow of steam into the return piping. Air may be vented from the unit by vents incorporated in the trap, or a vent valve may be provided at the condensate outlet of the unit.

This type of system may use steam-throttling control. Since the condensate returns to a pump rather than direct to the boiler, the unit-coil outlet may be located below the water line of the boiler, letting condensate flow to the inlet of the pump receiver by gravity.

Low Pressure—Vacuum Return. (p 96) This system is similar to the open-gravity system except that the return piping is maintained at a vacuum by a vacuum pump. Do not use air valves. This pump also serves as the means for returning condensate to the boiler.

High Pressure—Open-Gravity Return. (Above) A system operating above 15 psi is classed as high pressure. Condensate flows by gravity to an open sump or vented receiver and is returned

to the boiler by a boiler-return pump. This type system may use steam-throttle control provided condensation does not have to be lifted above return level of the coil. All steam-operated devices are usually equipped with bucket or float traps of the high-pressure type.

Traps and Air Venting. Quick air removal is important not only for quick heating and maximum efficiency, but also for preventing corrosion of the heating element. Entrained air causes corrosion. And corrosion can be eliminated by rapid air venting.

Traps are rated on continuous flow, that is, the amount of condensate that flows through the trap when the valve is in wide-open position. When selecting a trap, its rating should always be greater than the actual amount of condensate to be handled. Usual method of determining correct size of the trap is to multiply the normal operating condensation rate per hour by a suitable factor. This factor should never be less than 2, and sometimes may be as high as 5 or 6 depending on operating conditions. There are many reasons for this procedure, but most important, it assures rapid condensate removal and air venting during the heating-up period.

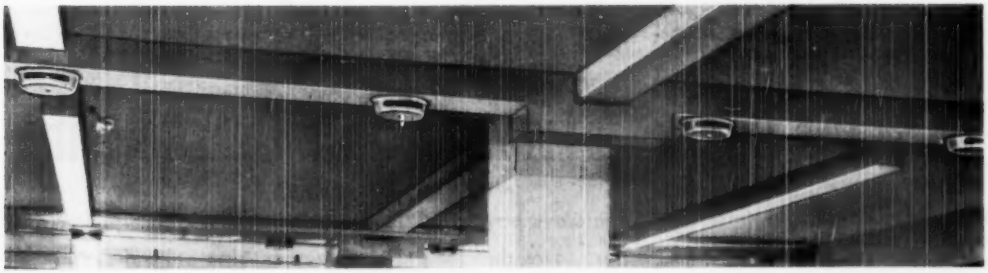
Conclusions. Regardless of the unit type selected or the operating steam pressure, it is highly desirable to select units that give low final air temperatures. It is also desirable to operate them at as high a fan speed as possible consistent with the application, for this results in the greatest capacity per dollar of cost. For best performance, locate the unit as near the floor line as practicable.

To insure economical selections, heat loss of the structure should be accurately determined by the method outlined in the *ASH&VE Guide*. There are short-cut methods for approximating building losses, but to be workable they are usually very conservative and will not suffice for economical selection. An additional hour or two spent on surveying the structure and evaluating the heat losses often pays off in lower operating cost.

Since stratification is a function of the type of unit used, it is important that the type be known so stratification effects may be reflected in the heat-loss calculations.

Automatic controls should always be an integral part of a unit-heater application, and while on-off control is satisfactory, more uniform temperature and air circulation result when face and bypass dampers or steam-throttling control is employed.

In general, it is desirable to select large-size units so fewer will be needed, thus resulting in reduced installation costs and minimum unit cost per 1000 Btu's. An exception occurs when the nature of the application requires that occupants be concentrated near outside walls. For such applications it is best to use a larger number of closely spaced small units arranged to flood the exposed walls with warm air. This arrangement prevents formation of cool air near the floor and assures comfort.



High-Velocity Air Diffusers

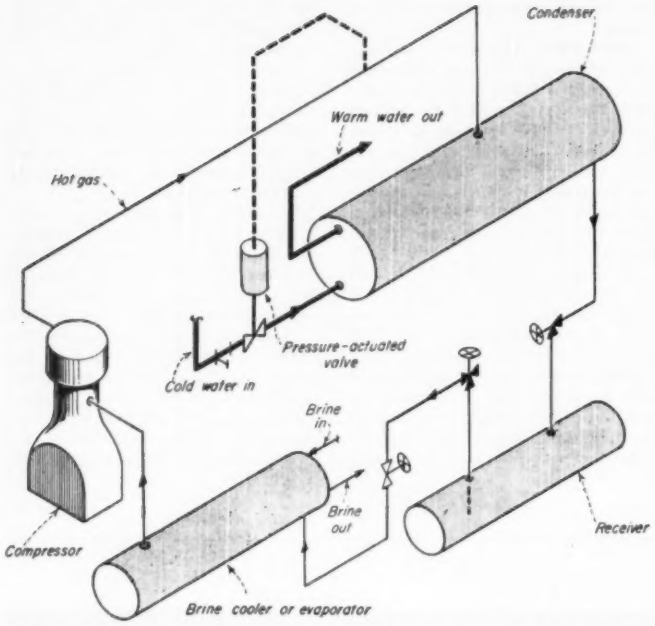
► PITTSBURGH's Kaufmann Dept. Stores have a $2,000,000 modernization program under way. One of the features will be a new air-conditioning system to supply the twelve top floors and augment the existing basement and main floor systems. When finished, about 1650 tons of refrigeration will be needed.

Like all other department stores, Kaufmann wanted to hang on to all possible sales space, office and storage areas. Usual solution is a compromise involving a number of unit air conditioners, serving individual floors and tied in with a central refrigeration system. But Kaufmann found another way out.

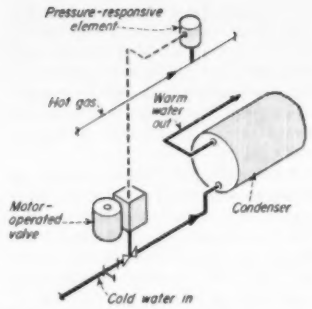
They put in a large central conditioning unit in a roof-top penthouse; then took over two elevator shafts to house the main vertical ducts for supply and return air to all floors.

At the ceiling level they use small, shallow ducts to carry conditioned air at about 30 miles per hr to 3500 special, uniformly distributed air diffusers. Each diffuser discharges between 90 and 180 cfm over an area of about 150 sq ft at a velocity of 2400 fpm. A trial bay, photo above, was used to test the diffusers.

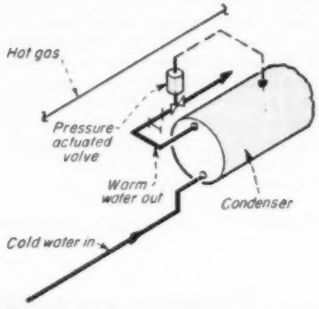
This system is the first to use the high-velocity or conduit principle for large interior zones common to department stores. The idea is to supply a colder air at a much higher velocity, but to mix it intimately with the store air and give a uniform, draftless air movement. A glass-fiber lining in the diffuser acts as a sound absorbing material to keep noise level below a nuisance point.



1 Pressure-actuated valve opens and closes with rise and fall in system head pressure. Head-pressure increase causes greater water flow, decrease a smaller flow



2 Motorized valve actuated by pressure-sensitive element in hot-gas piping



6 Pressure-actuated valves of some types are connected to condenser

Save Refrigeration Condensing

You always pay two bills in a refrigerating plant—power and water. Some designers and operators think only of the power bill. But recent shortages have made us water conscious. You can save water, and also power, with the proper control. Of these nine controls, one or more can cut waste in your plant

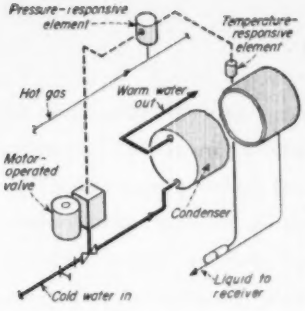
► AIM OF ANY CONTROL SYSTEM for condenser water is maintenance of proper head pressure with minimum amount of cooling water. With reciprocating compressors, excessive head pressure means loss of capacity and increased power input, POWER, Sept, pp 91-93. If you're operating a centrifugal you'll have to keep head pressure down or you'll also lose some of your capacity. In other words, a good control in the cooling-water circuit allows us to obtain maximum tonnage with minimum power and water input. It's important when a cooling tower isn't used.

Types. We can use head pressure to control cooling-water flow rate to condenser, Fig. 1. In this setup, rise in head pressure opens water valve permitting greater water flow through condenser. Decrease in head pressure allows valve to close slightly, reducing water flow. When used in systems with high head pressures, such as reciprocating units, this control gives good results. Head pressure remains nearly constant and water consumption is moderate.

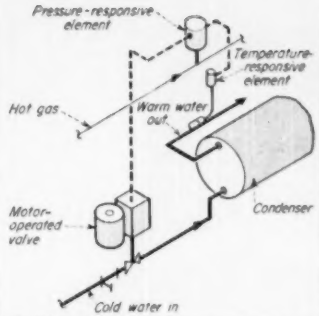
When system head pressure is low, say a few psi above or below atmospheric, control in Fig. 1 is not always satisfactory. With these conditions a motorized valve actuated by a pressure-sensitive element in the hot-gas line is better, Fig. 2. Positive control of water flow is obtained with only slight change in head pressure. This control is well suited to some centrifugals.

Where liquid temperature must be kept constant we can compensate pressure control as in Fig. 3. Change in liquid temperature increases or decreases value at which pressure-sensitive element operates. Motorized valve is commonly used with this control. Increase in liquid temperature reduces head pressure by permitting larger flow of cooling water. This control uses more water than those in Fig. 1 and 2.

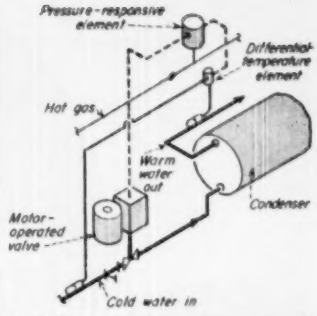
Pressure-actuated control, Fig. 1,



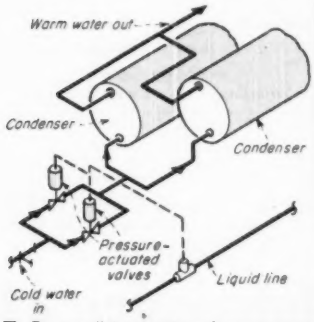
3 Liquid temperature compensates pressure element, varying operating point



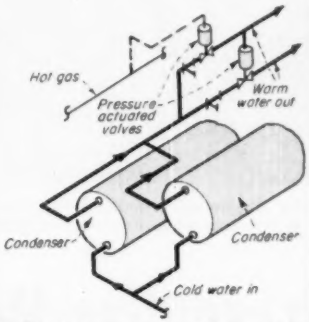
4 Water temperature compensates pressure element, varying operating point



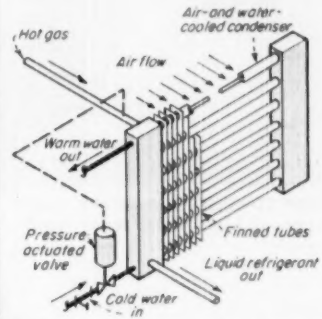
5 Differential element compensates the pressure element's operating point



7 For parallel operation of compressors and condensers this hookup is good



8 This is hookup you may find on older Freon-12 condensers. It's still good



9 For small units the combined air and water condenser shown can't be beat

Water With Proper Control

does not always give minimum condensing-water flow. By compensating pressure control with temperature control, Fig. 4, we can further reduce water consumption. In this arrangement we permit compressor's discharge pressure to vary within desirable limits for economical operation. Temperature control, actuated by water entering or leaving condenser, fixes maximum and minimum head pressure for system at available water temperature. Head pressure is always within range for best operation but is changed to suit water temperature as necessary. Since water flow is controlled by existing temperature, consumption is low.

Where high head pressure is desirable when difference between condenser's inlet and outlet water temperature is great, setup in Fig. 5 can be used. This is one step farther in temperature compensation, pressure control being compensated by temperature difference. This control gives good results when applied to systems where high head pressure is needed with large temperature differentials.

Some pressure-actuated valves, Fig. 6, can be operated by condenser pressure. Others are connected to refrigerant liquid line, high-pressure gage line or directly to compressor.

Parallel Operation. When two compressors are operated in parallel, water flow must be accurately controlled. Either one large valve, or two valves in parallel, Fig. 7, may be used. Valves shown are actuated by liquid pressure but other parts of high-pressure side are sometimes used. Good economy is obtainable with either one or two valves.

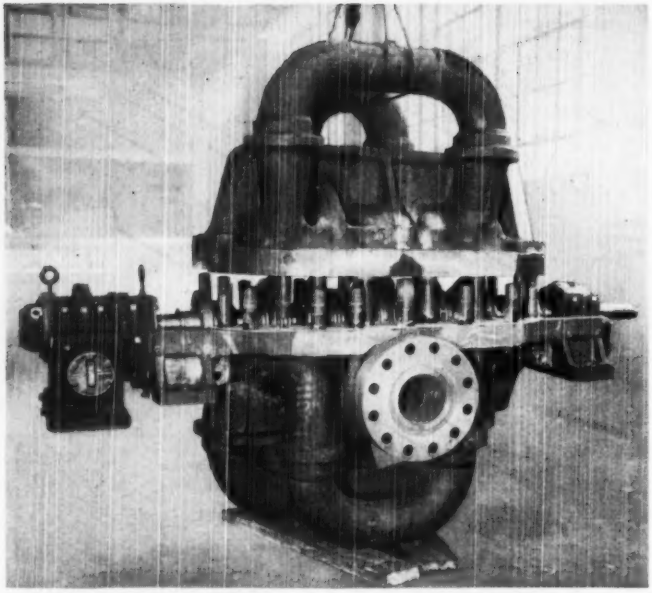
Older Freon-12 compressors operated in parallel were sometimes fitted with two valves as in Fig. 8. Upper valve is actuated by gas pressure, lower by water pressure.

Small Units. Watercooled condensers have often been fitted to small refrigerating units though it was known that air cooling was possible for many months of the year. Combined air-cooled and watercooled condensers now lick this problem. They use a finned coil with an inner tube for water. When entering air temperature at condenser exceeds about 85 F on Freon-12 systems, Fig. 9, head pressure opens water valve. Water flow continues until atmospheric temperature falls below 85 F. Then water valve closes and air does the cooling job. Excellent economy is obtainable.

How Controls Operate. Now that we know what types of controls are used for regulating condenser-water flow we can compare their operating characteristics. Plant designers and operators find these important because unless they are all known a control can't be properly selected.

When talking about refrigerant controls it's a good idea to think of them in terms of: Fouled condenser tubes, air-bound condenser, inlet-water tem-

(*Continued on page 164*)



HOW TO OPEN PUMP CASING. When opening a horizontally split-casing centrifugal pump, lift upper half of casing straight up so as not to damage the internal parts

Here are 40 rules for selecting, installing, operating and maintaining pumps. They insure low-cost, reliable service and the long troublefree pump life that every plant engineer is looking for and wants

By IGOR J KARASSIK
Application Engineer
Worthington Pump & Machinery Corp

Preventive Maintenance of

► IT IS DIFFICULT to give a complete picture of all precautions needed for flawless performance, but fundamental rules do help secure reliable service, least expensive maintenance and longest life. Maintenance starts not with repairs or replacement of worn parts, but right with selection of equipment and installation. So let's break the rules down into four groups—selection, installation, operation and maintenance:

Selection:

1. Describe to the manufacturer the liquid to be pumped including operating temperature, specific gravity and viscosity, presence of suspended foreign matter and reaction to various materials, if known.

2. Check the required capacities including expected variations from minimum to maximum.

3. Wherever possible, keep suction lift to a minimum or, if liquid is at or near its boiling point, provide sufficient static suction head.

4. If the discharge-head changes, tell the manufacturer the range of expected variations.

5. Advise him whether service is continuous or intermittent. This avoids using a light-duty pump on heavy-duty service.

6. Determine type of power best suited for the drive. Continuity of service depends on a reliable supply.

7. Do not install pumps in cramped quarters where maintenance and inspection are difficult. Often a vertical pump gains space or improves suction conditions.

8. Be sure there are enough spare parts. Pumps need periodic inspection and renewal of worn parts. For continuous service provide spare pumps to permit prompt maintenance.

9. Keep enough spares on hand. All pumps are not standard and stock spares may not be available. The manufacturer generally recommends spare parts.

Installation:

1. Install pump on a rigid foundation. Concrete built on solid ground is most satisfactory. If mounted on steel work, place pump directly over or as near as possible to main members, beams or walls.

2. Grout pump bedplate to foundation to stiffen the assembly, prevent bedplate shifting, reduce vibration.

3. Check pump and driver alignment; make needed adjustments. Even though the factory aligns a unit before shipment, a careful check is necessary after installation because of possible shifting in transit. If pump handles hot liquids, check alignment at operating temperature.

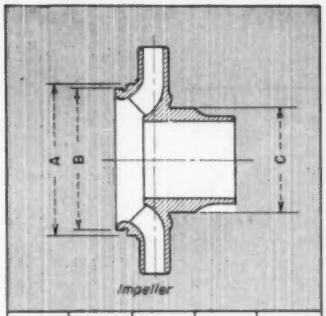
4. Do not let piping put strains on the pump. Alignment of pump and driver may be easily destroyed if forcing the piping into alignment distorts the pump on its bedplate.

5. Use liberal-size piping, especially for the suction. Generally it should be at least one or two pipe sizes larger than the suction nozzle. Do not use a short-radius elbow close to the pump's suction nor an elbow in a plane that disturbs even-flow distribution into the pump.

6. Provide vent valves at high points of pump. If vented vapors are noxious or inflammable, pipe them to safe place.

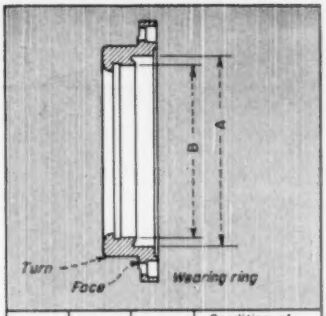
7. Provide warm-up connections for high-temperature liquids.

8. Provide bypass connection if pump is to operate against shutoff. Connect this bypass back to the suction or to some point where heat acquired by



Stage	A	B	C	
1st				
2nd				
3rd				
4th				
5th				
6th				
Remarks:				

IMPELLER WEAR. Form on which to record wear on impeller clearance surfaces



Stage	A	B	Condition of Face	Turn
1st				
2nd				
3rd				
4th				
5th				
6th				
Remarks:				

WEARING RINGS. Form on which to record the change in wearing-ring clearance

Centrifugal Pumps

the pump's liquid will be dissipated.

9. Provide suitable cooling-water source for watercooled bearings, stuffing boxes.

Operation:

1. Do not throttle pump's suction to reduce its discharge as this causes cavitation. Throttling the discharge is just as easy and not harmful.

2. Do not run a pump dry. Liquid lubricates and cools internal clearances, and a pump running dry generally overheats and seizes. Never start a pump that is not filled with liquid.

3. Do not run a pump throttled to too low a flow. Part of the power it consumes goes into heating the liquid and if flow is insufficient, pump overheats and seizes. As a rule of thumb, minimum flow is about 30 gal per min for every 100-hp input at shutoff.

4. Watch for performance irregularities. Investigate at once changes in the sound of a running pump. On large and important units observe hourly bearing temperatures and stuffing-box operation. Check pressure gages and flow indicator hourly, to see whether pressure and flow correspond to normal operation.

5. Do not completely stop stuffing-box leakage. Some is necessary to lubricate and cool packing.

6. Do not use too much cooling water in watercooled bearings. This practice cools the bearing housing to excess and causes moisture condensation, which contaminates the oil.

7. Use lubricant sparingly with antifriction bearings. With greases, pack bearing about one third full. If oil lubricated, level should not be above that marked on oil gage.

8. If stuffing boxes need repacking, use new material. Do not add one or two rings to old packing, this may displace the seal-cage if used, and plug the sealing liquid opening.

9. Semiannually, check for free movement of stuffing-box glands, clean and oil the gland bolts and nuts, inspect packing. Check pump and driver alignment. Drain and refill oil-lubricated bearings. Check grease-lubricated bearings for proper consistency and correct amount of grease.

10. Thoroughly inspect each pump once a year. Remove bearings, clean and examine for flaws. Remove packing and examine wear on shaft sleeves. Disconnect coupling and check alignment. Check and flush drain, sealing-water and cooling-water piping. Recalibrate all instruments and test pump performance.

Repair Maintenance:

1. Do not open pump for inspection, unless evidence is definite that performance has fallen off or unless noise or overload indicates internal trouble.

2. Use great care in dismantling during a complete overhaul. On horizontally split-casing pumps, lift upper half of casing straight up so as not to damage internal parts. Lift rotor out vertically to prevent injury to impellers, wearing rings or other parts. Mark all parts when removed, examine them and important joints. Make records of all clearances and compare with original ones.

3. Use special care when examining and reconditioning metal-to-metal fits, where stationary parts such as casing rings seat in the casing.

4. Clean casing waterways and repaint during complete overhaul. Examine waterways for corrosion or erosion. If wear is severe, consult manufacturer about more resistant materials.

5. Have new gasket available for complete overhaul. Except for some special designs, most centrifugal-pump casings have gaskets that may be damaged when opening the casing. Have new gaskets the same thickness as the original ones. Accurately trim their inner edge along internal portion of pump waterways. Remove all foreign material from casing before applying gasket.

6. Examine impellers for corrosion, erosion or effects of cavitation. If wear is severe better materials may be advisable. If cavitation is serious, it may be possible to relocate the pump to improve suction conditions or to obtain a specially designed impeller that is satisfactory under existing suction conditions.

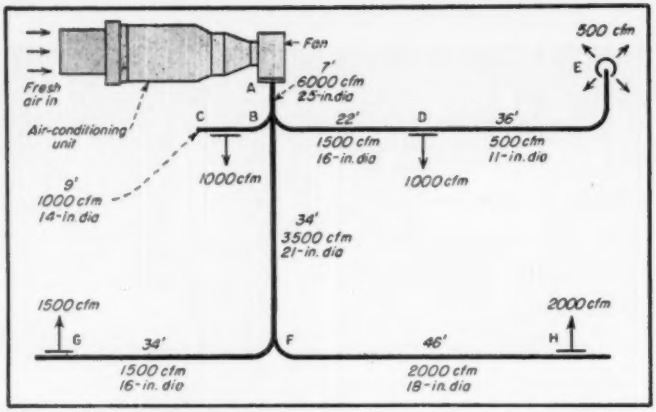
7. Check concentricity of new wearing rings after mounting on impeller. If necessary take a slight cut in a lathe to obtain a true circle.

8. Check all parts mounted on rotor for concentricity and trueness of faces against bores. This prevents bowing of the shaft when tightening up shaft nuts.

9. Restore shaft or shaft sleeves to proper surface condition at stuffing box. It may be possible to rebuild these surfaces by welding or metalizing. Generally, however, such practice is not a sure cure for the trouble, and new parts are preferred.

10. Keep complete records of inspections and repairs. Use these as basis of preventive measures to reduce frequency and cost of maintenance.

Fast and accurate method for figuring ducts used in air-conditioning and ventilation systems makes use of a simple tabulation. Don Kelland, of New York, N.Y., tells how to apply this method and why it saves you time and effort. Try it on your next duct job



DUCT LAYOUT can be drawn freehand; it records air quantities, run lengths and diameters of round ducts. Some values have been rounded off for ease in handling. This is permissible if velocities do not exceed allowable values and if ducts fit

Do Your Duct Estimating in 'Chunks'

► My system for figuring air-conditioning jobs is based on getting the most work done in the shortest time. So I've made closely related steps of (1) duct sizing (2) velocity checking (3) selecting duct gage (4) finding total weight of duct metal. Here's how it works.

I draw a freehand sketch of the system. Sketch above is typical. On this I mark all air quantities and duct lengths. Then I label each end of every duct and points where size changes. I don't draw the layout to scale; if important runs and other parts are shown in about their correct relationship you obtain good results.

Calculations. Once I've taken the layout from building plans I set up a table like that below. In this I enter letters representing various duct runs and then the air quantity flowing through each duct. Next, resistances are found and entered in table.

From a duct-friction chart I find the velocity at which the air flows and the diameter required for a round duct. With these data I go to a chart or table of rectangular equivalents for round ducts and choose width and height. While selecting rectangular dimensions I check with fan-outlet size, diffuser or supply-grille dimensions and beam depths to see that the job can be put in easily.

Up to now what I've figured is standard for all jobs. But since you need total weight of ducts and proper gage for cost estimates and specifications I figure them on the same table. This is done by finding duct perimeter in inches, converting to feet and multiplying by total length to find metal area. Then the area is multiplied by metal weight, lb per sq ft, corresponding to the gage. In the last column you have the weight of each run. By summing these, total weight of metal in the duct system is obtained. To this I usually add 10-15% of total weight for wastage.

Uses. Now let's see what we have. Our ducts have been sized, we know the velocity in each, and also the weight of each run. From total weight we can find metal cost by multiplying by cost per lb. With the weight of each duct run known we can select suitable hangers for it. When writing the specifications for the system we can include metal gage to be used, if desired.

I usually round off figures before entering them in the table and have done so here. Thus when I find a duct size of 23x23 in. I generally make it 24x24 in. if there's enough room on the job to put it in.

Power's Data Sheet. No. 200, which appeared in March 1949, p 146, can be used with this table. With it I follow the same procedure except I don't figure perimeter. I just multiply weight per foot by length and enter it in the last column of the table. Results are sufficiently accurate for usual jobs.

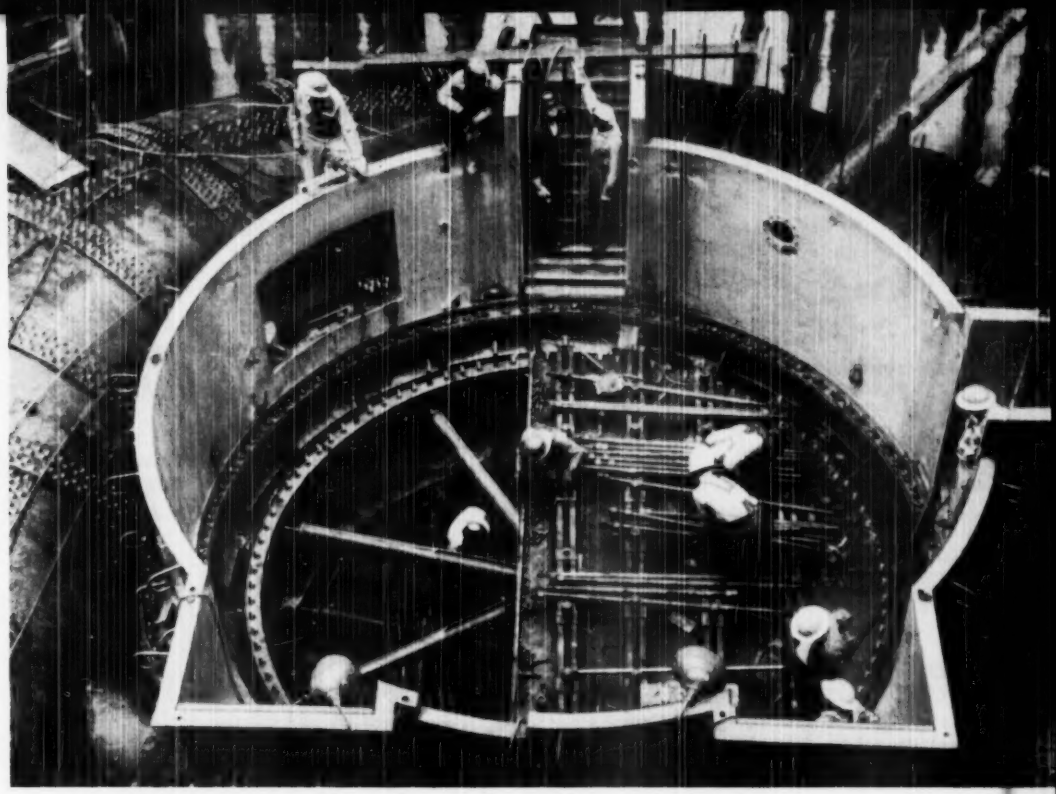
For accuracy when using this tabulation you must estimate length of elbows correctly. I use the ASHVE *Guide* or one of the standard handbooks that gives proper equations.

Duct Gage. Select duct weight or gage number from (1) a table of values recommended by local authorities (2) a list published by the insurance company or (3) *National Board of Fire Underwriters Standards for the installation of Air-Conditioning, Warm-Air Heating, Air-Cooling and Ventilating Systems.* These standards are recommended by the NFPA. For this example, I took gage numbers from Power's Data Sheet No. 200, but other values can be used where they are necessary.

CALCULATIONS FOR DUCT WEIGHTS IN AIR-CONDITIONING SYSTEM

Duct section	Cfm	Res, in./ 100 ft	Velocity, fpm	Duct dia, in.	Duct W x H, in.	Perimeter in.	Perimeter ft	Duct length, ft[1]	Metal area, sq ft	U.S. std gage	Wt lb/ sq ft[2]	Duct wt, lb
AB	6000	0.15	1775	25	24x22	92	7.67	7	54	24	1.0	54
BC	1000	0.10	975	14	14x12	52	4.33	9	39	26	0.75	29
BD	1500	0.10	1080	16	15x15	60	5	22	110	26	0.75	83
DE	500	0.10	825	11	10x10	40	3.33	36	120	26	0.75	90
BF	3500	0.15	1550	21	20x20	80	6.67	34	227	24	1.0	227
FG	1500	0.10	1080	16	15x15	60	5	34	170	26	0.75	128
FH	2000	0.10	1150	18	16x16	64	5.33	46	245	26	0.75	184
										Total weight		795

[1] Including elbows [2] "Black" sheets assumed



BULKHEAD ERECTION. To permit filling the scroll case and penstock with water, the case is bulkheaded at the top and bottom bolt circles of the speed ring. Also, bulkhead and scroll case are specially supported to take the water load

New Method Speeds Hydro Erection

Filling a hydraulic turbine's scroll case with water before casting it into the concrete foundation cuts time for the job by four weeks. It has other advantages over the older methods

► AN IMPROVED METHOD of pouring concrete around hydroelectric-turbine scroll cases substantially reduces construction cost and time needed for the job. The U.S. Corps of Engineers is applying this procedure to three 62,500-hp units at Center Hill and six 62,500-hp turbines being installed in Wolf Creek, both projects on Cumberland River system in Kentucky and Tennessee.

With this method the 150-ton scroll case of each unit is imbedded in concrete in one pour. The pour, about 24 ft deep, contains 1400 cu yd of concrete and is made in one day. Allowing time to install bulkheads and do other incidental work, the job now requires about one week. The old method took five weeks. Concrete was put in, in ten shallow lifts, with 3- to 4-day intervals between pours.

Before pouring concrete by the new method, scroll case and penstock are filled with water from the reservoir at full pressure. This prestresses the scroll case. At the same time, the cool water shrinks the case to operating temperature, thus making all corrections for elastic deformation. Also, a check is made for water tightness, and recaulking can be done under pressure until the scroll case is watertight. This is especially important with a butt-strap, plate-steel scroll case, which is difficult to check for water tightness by the commonly used "in-the-dry method."

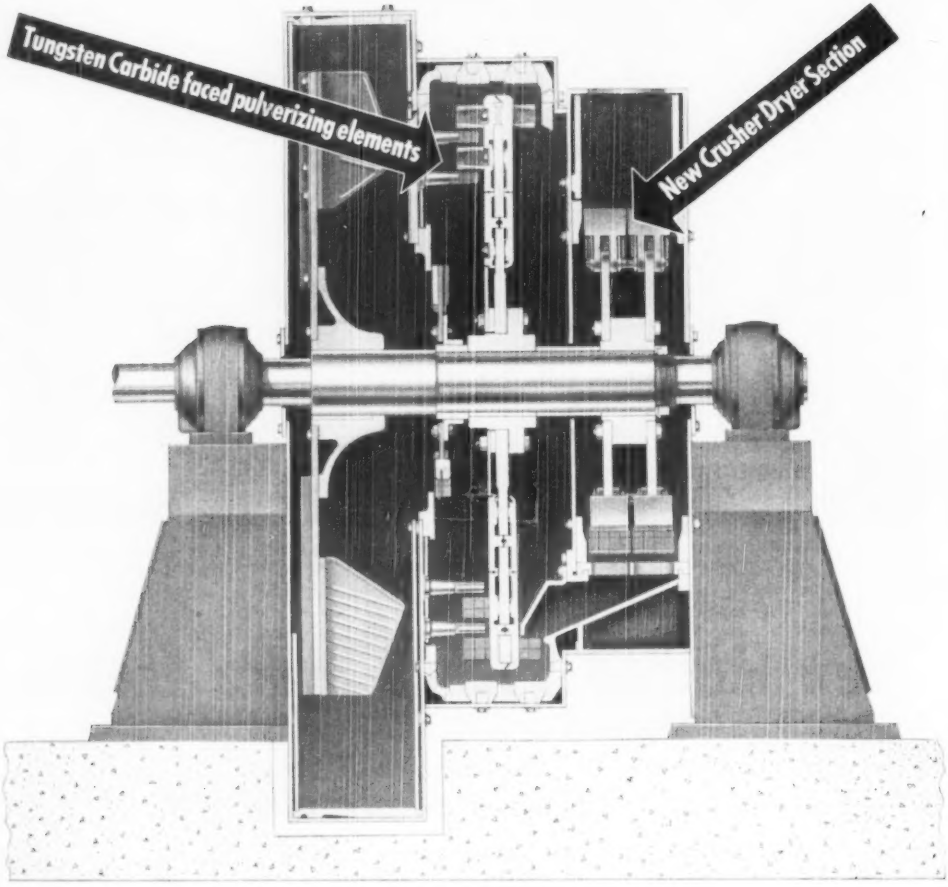
Weight of water in the scroll case opposes uplift of the concrete to permit a continuous pour without danger of floating the casing or causing misalignment. Water is circulated through the scroll case during the concreting operation to help dissipate the heat while the concrete is setting. Circulating the water also helps to keep the case in uniform alignment by preventing distortion that changes in air temperature would otherwise cause.

Top and bottom opening of scroll case are bulkheaded by two 1¼-in. steel plates. One plate is bolted to the lower-bolt circle and the other to the upper-bolt circle of the speed ring. Plates are connected by 2¼-in. stay bolts on about 2½-ft centers. These stay rods extend through stiffeners, made of 11½-lb channels placed back to back, and mounted outside each plate.

Plates are sealed against leakage by ⅛-in. sheet-rubber gasket material.

For more hydro data, turn to page 108

Announcing a tremendously



RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
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improved Riley Pulverizer

No capacity reduction with increase in moisture.

In the crusher dryer section where coal is crushed to a fine granular state, approximately 40% through a 50 mesh screen, representing about 5% of the work to be done, free moisture is evaporated from coal. The crusher dryer section acts as a flash dryer. Coal then enters pulverizing section where 95% of the work is done, completely free of moisture which would affect pulverizer performance and capacity. The crusher dryer section is designed with ample capacity for the highest moisture coals and as moisture is evaporated before coal enters the pulverizing section, moisture has no effect on pulverizer capacity or performance.

Tramp iron, iron pyrites and other foreign materials in coal rejected.

The crusher section of the pulverizer rejects tramp iron, iron pyrites and other hard foreign substances in the coal, preventing any materials from entering the pulverizer section which could cause damage.

Pulverizing elements faced with tungsten carbide.

Pulverizing elements are faced with tungsten carbide, assuring long periods of service without outage for maintenance and resultant low maintenance costs. Numbers of Riley pulverizers equipped with tungsten carbide faced parts have been in operation over two years without showing appreciable signs of wear, indicating at least several additional years of service before replacements are necessary. Over 40,000 tons of coal have been pulverized by a mill having a six-ton per hour capacity with indications that 150,000 tons will be pulverized before requiring replacement.

Fineness sustained over years of operation.

Because the life of the tungsten carbide faced pulverizing elements is so long, fineness of pulverization is maintained over years of operation. Tests on existing installations show no falling off of fineness after over two years of operation. No adjustments are necessary to maintain fineness.

Unusually high capacity per unit of space.

The improved Riley pulverizers have an unusually high capacity per unit of floor space and height, permitting their installation under crowded space conditions. Because of their lower weight and quiet vibrationless operation, heavy foundations are not required.

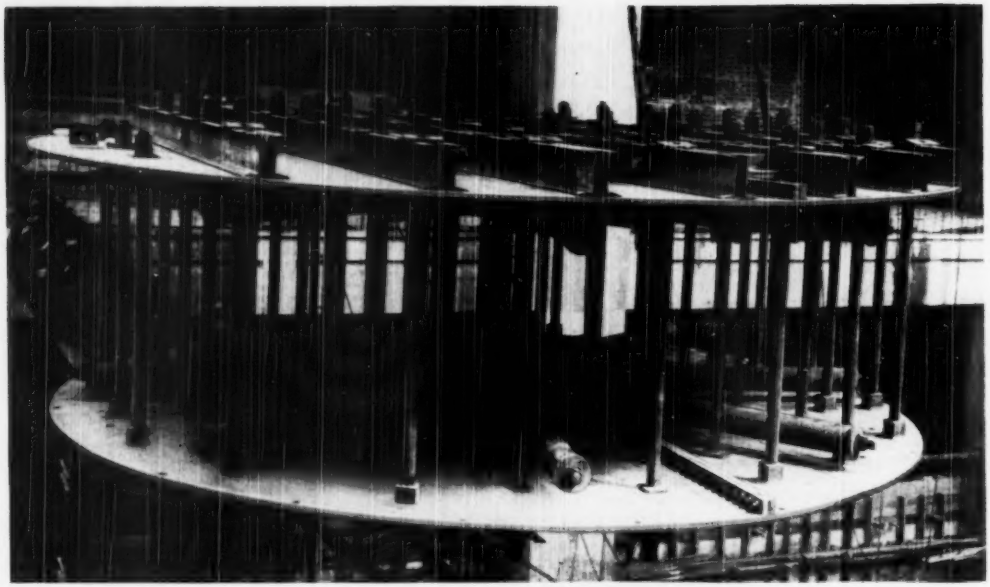
A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to [illegible] modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS · WATER-COOLED FURNACES · STEEL-CLAD INSULATED SETTINGS · AIR HEATERS

SPEEDS HYDRO ERECTION *Continued from page 105*



BULKHEAD ASSEMBLED. The bulkhead weighs 25 tons. It is constructed of 1.25-in. steel plate stiffened by 11.5-lb channel irons, placed back to back. A 6-in. valve in the bottom plate lets water flow through casing to cool the concrete

Stay bolts are sealed with rubber-ring gaskets compressed into the beveled edge of holes in plates, welded to top and bottom ends of pipe sleeves around each bolt. These pipe sleeves and their end plates serve as spacers between the bulkhead plates.

Two 8-legged spiders within the bulkhead hold the speed ring in true round. One of the spiders is just below the top plate and the other just above the bottom plate. Spider legs, of extra heavy 6-in. pipe mounted on a central hub, have built-in jackscrews.

A 6-in. pipe properly gasketed forms a hole through the center of bulkhead for the piano-wire center line. From this line measurements may be taken to check alignment during concrete pouring.

A 6-in. valve in the lower bulkhead plate, when open, discharges to the draft tube and screws to circulate water through the scroll case to hold water temperature nearly constant and help cool the concrete.

Bulkhead was designed for pressure corresponding to reservoir level at spillway crest, a static head of 165 ft. This bulkhead can be used on both Center Hill and Wolf Creek units.

Bulkhead is supported to carry weight of the confined water. This is done by four bents made of 8-in. channels welded by clip angles to the bottom of the draft tube lines. Weight of water in the scroll case is taken by ten concrete saddles spaced midway between the pipe jack supports. The turbine manufacturer supplies them for the support of the casing during erection.

Constructed entirely of commercially available structural-steel shapes, the bulkhead weighs 25 tons. It does not require any machine work other than drilling of bolt holes. To simplify transportation, the bulkhead is split off-center enough to clear the spider hub. Edges of the plates at the split are flanged and connected by closely spaced bolts, which draw up against a sheet-rubber gasket.

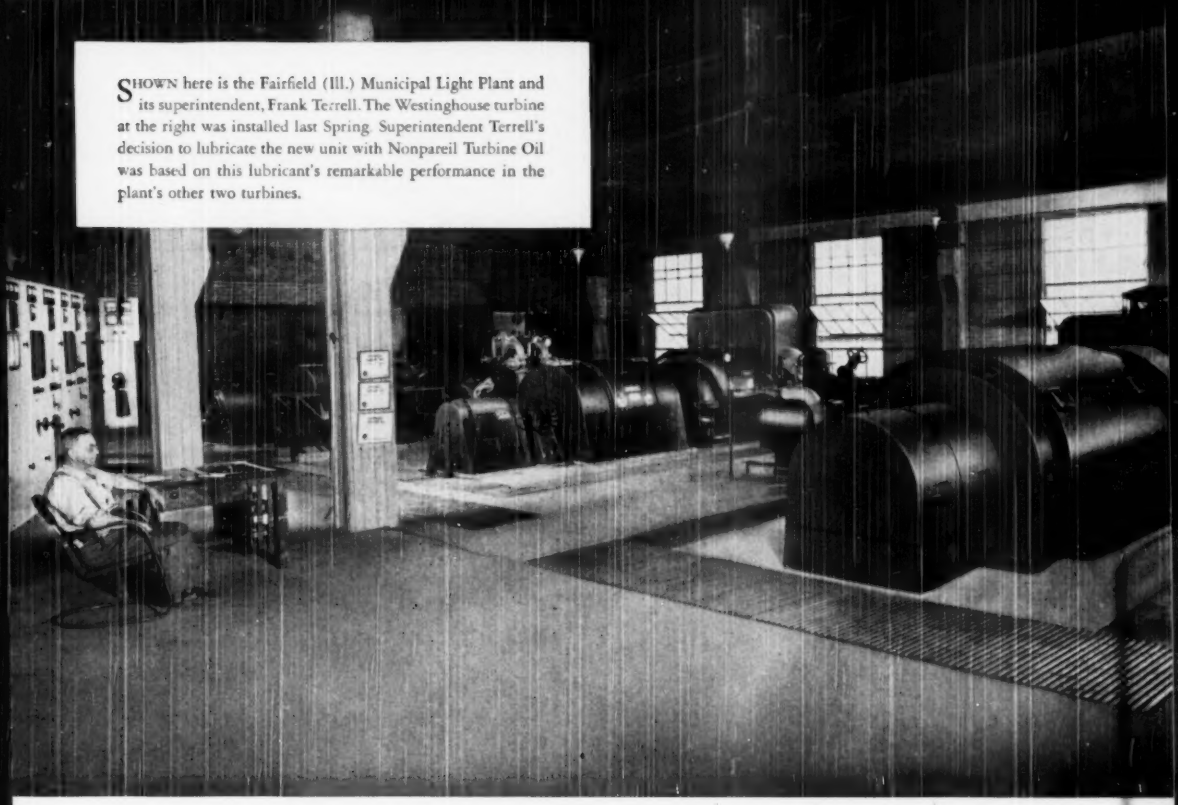
H B Elder, veteran engineer for the Corps of Engineers developed this method. He is now resident engineer on the Center Hill project on Carney Fork of Cumberland River in Tennessee. Massman-Metcalf and Hamilton Construction Companies are building the powerhouse. Fabrication and erection of the penstock extensions, scroll cases and turbines are being done under contract by the Baldwin Locomotive Works.

Center Hill and Wolf Creek are two of 16 hydroelectric power and river-regulation projects that U.S. Corps of Engineers proposes for Cumberland River and its tributaries. These have an ultimate capacity of 1,100,000 hp. Of these projects, Dale Hollow on the Obey River has gone into operation with two 25,000-hp units. A third to complete the project is on order. Center Hill with three 62,500 units will go into operation late this year or early in 1951. Its dam, 2160 ft long, 240 ft high, forms a storage reservoir of over 2,000,000 acre-ft.

Wolf Creek, which is the largest project in the river's development, will be the third largest hydroelectric plant in eastern United States. Its dam, 5736 ft long, 240 ft high, will form a reservoir with a storage capacity of over 6,000,000 acre-ft. This will be equally allotted to power generation, flood control and river regulation. This project will go into operation in 1952.

Three other fairly large power projects are: Old Hickory with about 120,000 hp, Carthage with about 110,000 hp, and Celina, a 75,000-hp project. These developments have been authorized by Congress and plans are now being drawn for their construction.

Other power projects in the Cumberland River system development include: Stewarts Ferry, 20,000 hp; Three Island, 12,000 hp; Rockcastle Narrows, 12,000 hp; Laurel, 25,000 hp; Helenwood, 50,000 hp; and Devils Jump, 30,000 hp. These plants will have a total capacity of about 150,000 hp. Congress has authorized Three Islands and Stewarts Ferry projects, and plans for their construction have been completed.



SHOWN here is the Fairfield (Ill.) Municipal Light Plant and its superintendent, Frank Terrell. The Westinghouse turbine at the right was installed last Spring. Superintendent Terrell's decision to lubricate the new unit with Nonpareil Turbine Oil was based on this lubricant's remarkable performance in the plant's other two turbines.

Here's minimum turbine-oil maintenance

CENTRIFUGING once a year is the only turbine-oil maintenance found necessary at the Fairfield Municipal Light Plant, Fairfield, Illinois. This practice has been followed ever since 1940, when Nonpareil Turbine Oil first went into the plant's new 1500-KW Westinghouse turbine. The same routine has been employed on a second Westinghouse unit of 2500 KW, installed in 1942.

During these 8 and 10 years of operation, the original fills of Nonpareil have not been removed either for treating or for replacing. Neutralization numbers have stayed below 0.08 mg KOH/gm. Oil systems have remained entirely clean.

Such lubricating economy and efficiency is not limited to 10- or 15-year records with Nonpareil Turbine Oil. Each fill of Nonpareil carries a written guarantee that it will remain below a neutralization number of 0.15 mg KOH/gm. *for the life of the turbine* it lubricates. 21-year service records of Nonpareil provide evidence of its ability to end acidity trouble and oil maintenance once and for all.

A Standard Oil Lubrication Engineer will be glad to supply you with actual case histories of utility operations in which Nonpareil Turbine Oil has reduced lubrication costs as much as 68%. Your letter will obtain the Engineer's services.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

NONPAREIL
TRADE MARK
Turbine Oil

STANDARD OIL COMPANY (INDIANA) STANDARD

SEND FOR YOUR COPY

Here's help for bearings in "HOT WATER"

New booklet tells how STANOLITH Greases solve wet-hot problems

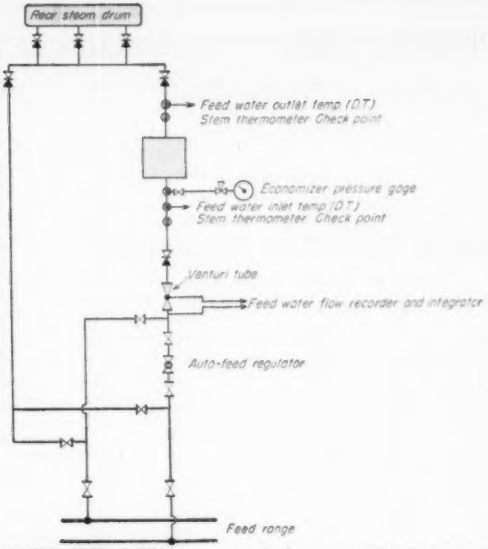
HOW TO LUBRICATE bearings which operate under extremely wet conditions, and at the same time, are subjected to high temperatures? If that is one of your problems, the booklet illustrated above holds the solution.

It tells you about the outstanding qualities of Standard Oil's new STANOLITH Greases. It explains why these lithium soap products—unlike soda soap or lime soap greases—will withstand *both* heat and water. The booklet contains evidence of this ability. It gives actual case histories of some of the many different jobs on which STANOLITH Greases have eliminated troubles caused by high temperatures, presence of steam or water, and high speeds. It also describes successful low-temperature service.

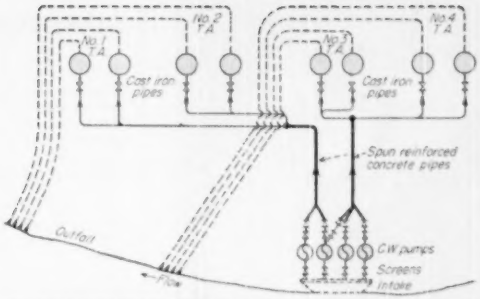
Study this wide range of applications. Discover how the two grades of STANOLITH Grease not only can solve difficult lubrication problems but can save you the cost and trouble of stocking and using a variety of special greases. Send for this information. Write for your copy of the STANOLITH booklet today. Simply address your letter to:

Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

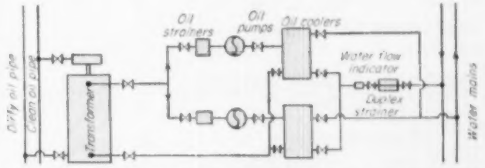
STANDARD OIL COMPANY (INDIANA)


Rear steam drum
Feed water outlet temp (D.T.) Stem thermometer Check point
Economizer pressure gage
Feed water inlet temp (D.T.) Stem thermometer Check point
Venturi tube
Feed water flow recorder and integrator
Auto-feed regulator
Feed range

BOILER FEED PIPING is one of the most critical systems in a plant. Operators must know all details for quick action



CIRCULATING-WATER SYSTEMS of most plants may be largely buried, draw diagram during erection, file for future reference



OIL-COOLING SYSTEM for large transformer presents maze of piping in many cases, diagram helps interpret functions

To Know Your Plant—Use Diagrams

► USING DIAGRAMS for the electrical end of a plant has been universal practice for many years. By thoughtful and careful layout simplified diagrams can be made for the most complicated circuits. These can be easily related to actual equipment with little trouble if properly drawn and labeled.

Where the mechanical equipment is concerned I find that few or no attempts have been made to reduce actual piping systems to paper in simplified form with any degree of thoroughness. Exceptions are the usual condensate and feedwater heating systems.

I am not advocating the drawing of numerous unnecessary diagrams. But remember that what appears superfluous to the experienced plant designer may often be the operator's only authoritative guide. Information filed in the designer's office is of no help to the operator out in the plant. Furthermore, the information must be put in understandable form for him —the single-line diagram. Too often the engineering assistant fails to understand the background of the operator who may be responsible for safety of the actual equipment.

BY T. H. CARR, *Manager*
City of Bradford Electric Dept, England

In the majority of cases, operators have only an elementary engineering education. They need close supervision during their first working year and all the visual aids possible, to understand their equipment. Some of the better operators will move up the ladder during the life of the plant.

Diagrams as Progress Charts. When power-plant diagrams are drawn during the initial stages of plant planning and erection, they can also serve as progress charts. Choosing a suitable color scheme aids this application.

I have found that there are few, if any, items of a power plant that cannot be drawn in diagrammatic form. Later applications more than justify the initial cost of making the diagrams.

During the planning and design of a power station, such diagrams have proved very helpful for reference at progress meetings and have saved considerable amounts of time. Where plant extensions are likely to take place in the near future, additional time savings have been made. Sizes of diagrams should be standardized for convenient filing and handling. I have found 11x17 in. the most convenient.

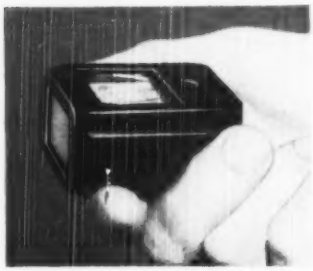
Make File Accessible. For quick location in the file, these drawings must be given reference numbers. List them in an index and see that they are accurately filed. To insure their being used, make the file accessible to the operators. For long life of the diagrams, mount them on cardboard and varnish all surfaces. This prevents deterioration from moisture.

The sample diagrams above illustrate the type that I have found useful. Of course, it should not be inferred that handing over this type of information to the operators relieves the senior men of their responsibilities.

Our experience has shown that providing power-plant line diagrams fosters good will between operators and management and creates a team spirit, both of which are essential to efficient operation. The younger ambitious operators can use them for making valuable suggestions to improve operation.

LIGHT OUTPUT in some plants drops 50 to 80% before cleaning; poor economy

LIGHT METER tells at glance how fast dirt builds up on the lighting fixtures



I: LIGHT ABSORPTION BY DIRT—DIRECT-TYPE INDUSTRIAL LUMINAIRES

Type of area	*Approx percent light absorption by dirt per month*
Clean work—cleaned air	2
Some fumes and dirt	4
Average machine shop	6
Heavy fumes or dust	8
Foundry or heavy welding	12
Extremely dirty location	16

II: CLEANING FREQUENCY FOR BEST ECONOMY

(Number of months between cleanings)

Annual cost per luminaire (excluding cost of cleaning)	*Cleaning cost per luminaire*	*Light absorption by dirt per month*					
		2%	4%	6%	8%	12%	16%
$10.00	$0.25	4.5	3.0	2.5	2.0	2.0	1.5
	0.50	6.5	4.5	3.5	3.0	2.5	2.0
	1.00	9.0	6.0	5.0	4.0	3.5	3.0
	1.50	11.0	8.0	6.0	5.0	4.0	3.5
$20.00	$0.25	3.5	2.5	2.0	2.0	1.5	1.5
	0.50	5.0	4.0	3.0	2.5	2.0	2.0
	1.00	7.0	5.0	4.0	3.5	3.0	2.5
	1.50	9.0	6.0	5.0	4.0	3.5	3.0
$30.00	$0.25	3.0	2.0	2.0	1.5	1.0	1.0
	0.50	4.0	3.0	2.5	2.0	1.5	1.5
	1.00	6.0	4.0	3.5	3.0	2.5	2.0
	1.50	7.0	5.0	4.0	3.5	3.0	2.5
$40.00	$0.25	2.5	2.0	1.5	1.5	1.0	1.0
	0.50	3.5	2.5	2.0	2.0	1.5	1.5
	1.00	5.0	3.5	3.0	2.5	2.0	2.0
	1.50	6.5	4.5	3.5	3.0	2.5	2.0
$50.00	$0.25	2.5	2.0	1.5	1.0	1.0	1.0
	0.50	3.5	2.5	2.0	1.5	1.0	1.0
	1.00	4.5	3.5	2.5	2.0	2.0	1.5
	1.50	5.5	4.0	3.0	3.0	2.0	2.0

How Often Should Lights Be Cleaned?

By **J C FORBES**, *Lamp Dept, General Electric Company*

► LIGHT LOST BY DIRT on lighting luminaires (fixtures) is a daily investment loss. And this loss must be balanced against the labor cost of keeping the units clean. Here's how to determine the most economical cleaning frequency.

In general, four things determine the best frequency. These are annual luminaire cost (usually 1/6 actual cost), annual maintenance cost (you add labor, lamps and incidental repairs), annual power cost, dirt rate.

The last, the dirt rate, requires two sets of readings with your light meter. Start off by getting a good average reading. Then clean the lamps and reflectors and take another set of readings. Of course, take both sets of readings in the same place. Difference in these readings divided by after-cleaning reading is the dirt rate. Double-check your results with Table I above.

Knowing annual cost, cleaning cost, and light absorbed by dirt per month (2 to 16% columns) you can pick out the cleaning frequency for best economy. Remember, annual cost per luminaire is sum of annual luminaire cost, annual maintenance cost and annual power cost. Cleaning cost varies according to mounting height, skill of men, accessibility of equipment, wage scale and cost of materials.

Chart Plus Amp Reading Gives Synchronous Motor Performance

By **G L OSCARSON**, *Chief Application Engineer, Electric Machinery Mfg Co*

► BY SIMPLY READING your ac ammeter (tapped into the motor primary leads) and using the chart, the following can be approximated: Power component and reactive component of motor current, horsepower output of motor, operating pf of motor.

Five Steps. Here's how to use the chart on facing page:

1. Divide load current, as read on the ac ammeter, by motor full-load current given on motor nameplate.

2. Using this ratio of ammeter reading to nameplate current as a radius, swing an arc with *O* as a center. Continue till it intercepts the pf line corresponding to the motor rated pf.

3. Read the ratio of this intercept on horizontal scale. This ratio times nameplate current is then the active component of the motor current.

4. Note ratio of this intercept on the vertical scale. This ratio times the nameplate current is then the reactive component of the motor current.

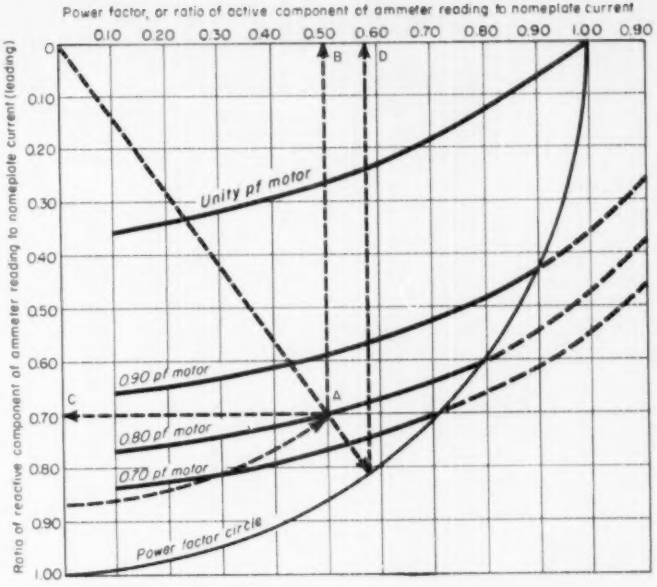
5. Extend the radius until it intercepts the pf circle. Read on the horizontal scale the pf at which the motor is operating.

EXAMPLE. Assume a 300-hp 440-v 0.8-pf synchronous motor with a full-load nameplate current of 390 amp. The ac ammeter on the motor control reads 340 amp. Here are the steps:

(1) $\frac{340}{390} = .87$, or the ratio of ammeter reading to nameplate current.

(2) With *O* as a center, swing a ratio of .87 until it intersects the 0.80 pf motor line at *A*.

(3) Active component ratio, *B*, is .50. Nameplate current times .50 equals 195 amp.


Power factor, or ratio of active component of ammeter reading to nameplate current
0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00 0.90
Ratio of reactive component of ammeter reading to nameplate current (leading)
0 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
B
D
Unity pf motor
0.90 pf motor
C
A
0.80 pf motor
0.70 pf motor
Power factor circle

$$\text{Hp} = \frac{195 \times 440 \times 173}{746} = 198$$

(4) Reactive component ratio, *C*, is .70 Nameplate current times .70 equals 273 amp.

$$\text{Reactive kva} = \frac{273 \times 440 \times 1.73}{1000} = 208$$

(5) Pf, *D*, equals .58 (leading).

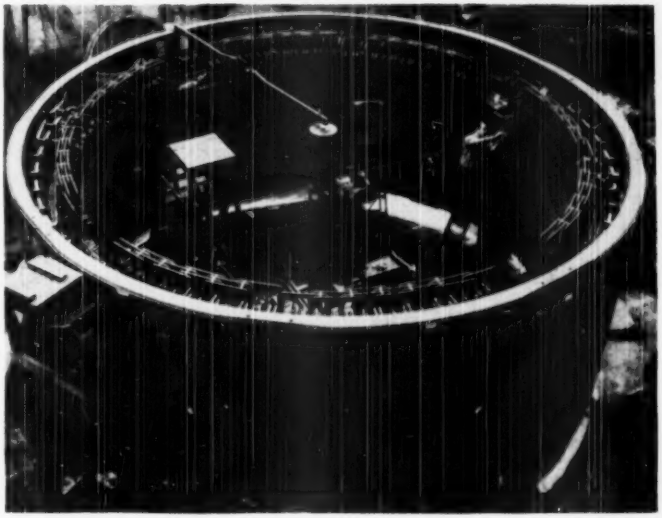
Curves are based on full-rated excitation applied to the motor and represent average values. Variations in individual motor characteristics and variations in line voltage from nameplate value will affect the line current.

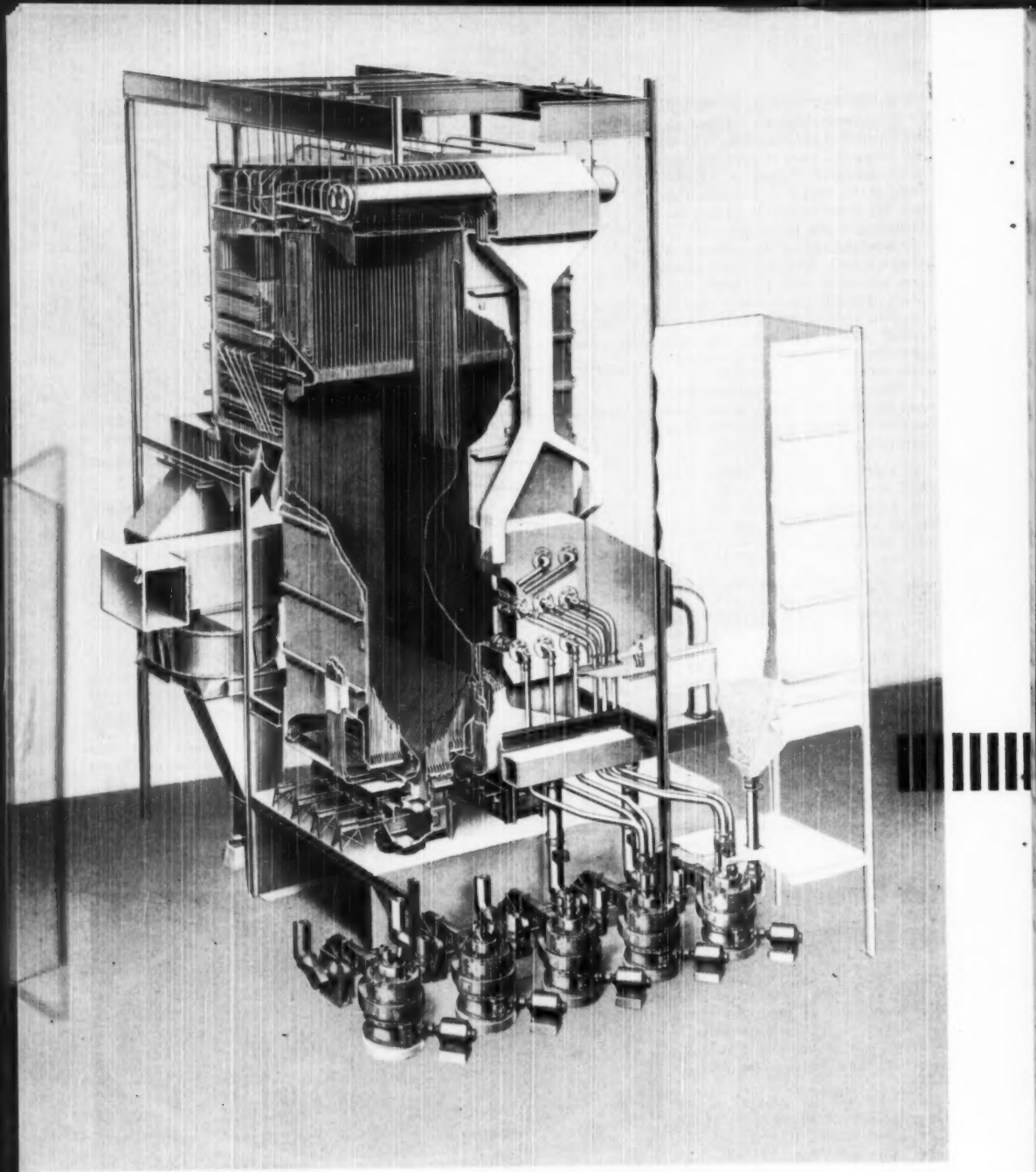
New Generator For Seattle

► THIS 66,700-KVA WATERWHEEL GENERATOR will soon be producing power for the City of Seattle, Washington. It is being built at the East Pittsburgh plant of the Westinghouse Electric Corp.

The unit will be installed in the Gorge powerhouse located on the Skagit river above Seattle. Here it will join three other generators, two of which have been in operation since 1921. When completed the new generator will weigh 580 tons, stand 21 ft high, and measure more than 36 ft in diameter.

Rotor will weigh 287 tons and will turn at 164 rpm. The two workmen shown are using a pin gage to check the stator for roundness before mounting the end bracket.





ENOUGH STEAM FOR 156,000 KW IN ONE PACKAGE...

Mammoth steam generator supplies 1,370,000-lb-pr-hr 1450-psig 1050-F steam continuously. Five mills feed 16 burners arranged in three horizontal rows. Circular-type burners may utilize coal or oil. A divided furnace with dry bottom discharges the combustion gas through screen tubes into secondary superheater. Gas then flows through downflow gas pass over primary superheater and through bypass depending on superheat-control damper setting. Economizer section precedes two regenerative air heaters. Walled area underneath boiler's ash hoppers accommodates two full-size motor trucks to receive and take away refuse. Interlocked ash gates prevent air leakage into furnace. Find man on burner platform, *right*

HUDSON AVE STATION stands on East River, has eight units with nameplate rating of 770,000 kw. Overhead pipeline, *left*, feeds steam to Gold St, one block away. Building for new topping unit under construction, *right*, called the Annex

1,370,000-Lb Boiler Tops Capacity Record at World's Largest Station

BY H. KNECHT, *Mechanical Plant Engineer, Consolidated Edison Co. of New York, Inc.*

Hudson Avenue Station of Con Edison, in New York, long-time capacity-record holder, acquires giant-size steam generator. Boiler supplies new topping unit exhausting at either 280- or 410-psig to eight existing low-pressure steam turbines

► GROWING SYSTEM LOADS led to installing a topping unit at Hudson Avenue Station of Consolidated Edison Co of New York. Now under construction is a 1,370,000-lb-per-hr boiler, feeding steam at 1450-psig, 1050 F to a 60,000-kw topping turbine. The latter will exhaust about 1,000,000 lb per hr to existing low-pressure units at either 280 or 410 psig.

Steam Generator. New unit will be housed in a separate building behind the existing station and tied in electrically as well as by lines carrying steam, water, air and fuel, and a conveyor belt. Largest occupant will be the giant boiler, which can burn pulverized coal or oil. Of the five coal pulverizers, four will be able to carry full load.

A center wall equally divides the radiant dry-bottom furnace, which can evaporate 1,370,000 lb per hr, with 450-F feedwater. Superheater has two sections, secondary high-temperature section of pendant type hangs at top of furnace behind screen tubes. Primary low-temperature section in the down-flow-gas pass has three banks of horizontal tubes. Dampers, across full width of boiler, automatically control superheat by diverting gas from primary section to the bypass.

Three decks of horizontal tubes make up the main economizer. Secondary economizer in the gas bypass has four decks of horizontal tubes.

With all flue gas passing over superheater surface, full steam temperature will be developed at 75% of boiler capacity, when burning coal. With fuel oil firing, lower gas temperature and flow cause a lower steam tem-

perature. Recirculating flue gas from air-heater inlet to bottom of furnace corrects the tendency to drop steam temperature. Recirculated flue gas reduces furnace absorption so needed heat remains in furnace gas at entrance to the superheater. By this means full temperature is also developed at 75% capacity with oil firing. Using recirculation with pulverized-coal firing will broaden the steam-temperature control range, though this has not been specified in the design.

Two regenerative air preheaters have basket elements in three layers. The bottom layer can be conveniently removed for cleaning.

Air drives 20 automatically-sequentially operated steam soot blowers. Eight for the superheater are retractable, ten for the economizer are semiretractable, and two for the air heaters are single nozzles.

Fans. Two forced-draft fans each serve the boilers 200,000 cfm of air at 11-in. water pressure. These vane-controlled fans are driven by 450-hp motors. Ductwork and ventilating fans feed warm air to the f-d fan inlets from the upper part of the boiler house. This minimizes corrosive condensation on the air-preheater surfaces.

Two induced-draft fans each handle 350,000 cfm of flue gas at 16.3-in. water pressure. 1250-hp motors drive the vane-controlled fans.

Fuel and Ash Handling. Existing station towers hoist coal from the barges at the river front. An automatic trolley-car system distributes coal to the bunkers. A new hopper on this system will receive coal for the new boiler. From here a 600-tph 500-ft 38-in.-wide belt conveyor carries coal across a bridge to the Annex. A Bradford breaker receives coal and discharges it to the bunkers via a conveyor belt. The bunkers located adjacent to the boiler hold 4000 tons. The coal bunkers terminate ten feet above the mills. Bunker design always keeps at least two of the walls vertical at all elevations. Stainless-steel lining at the bottom of the bunkers gives a smooth surface for the coal to flow over.

Fuel oil will be pumped from oil barges at the existing dock through a 12-in. line on the bridge to six underground storage tanks at the Annex. Individual vertical pumps at each tank (total 1,000,000-gal capacity) will pass oil through heaters to the burners.

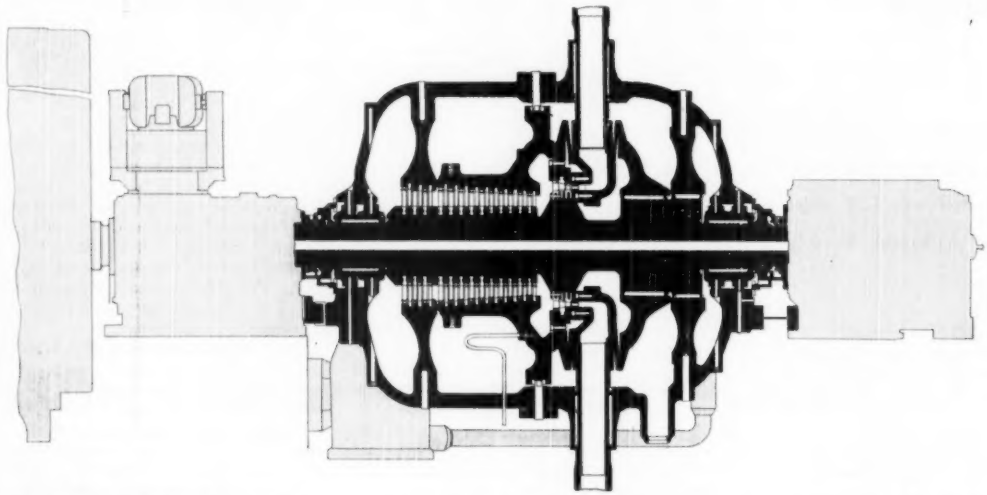
Hydraulically operated gates in the boiler-hopper bottom discharge ash directly into motor trucks. A combination mechanical-electrical precipitator will remove 97% of flyash when handling 577,000 cfm of 270-F gas. Mechanical catcher has 1212 9-in.-dia cyclones, designed for 80% efficiency. This is followed by an electrical precipitator, designed for 85% efficiency, having five parallel sections. Each section has outlet dampers so they may be isolated when rapping.

A vacuum system will remove flyash from the precipitator hopper delivering it to a flyash silo. A rotary-type flyash conditioner takes ash from the silo and discharges it into trucks.

Turbine Has Two Steam Chests

The 3600-rpm single-cylinder noncondensing topping turbine has a nameplate rating of 60,000 kw and maximum capability of 66,600 kw. Blading consists of a velocity-compounded impulse element followed by 14 reaction stages. Turbine has two steam chests to handle the large steam flow. Each chest, one on each side of the turbine cylinder, has four governing valves making a total of eight for the unit.

Steam chests connect to the flexibly mounted cylinder nozzle chambers through steel tubing. Two hydraulically operated, combination, trip-and-throttle valves admit steam to the turbine. Throttle valves, steam chests, turbine inlet piping, governor valves and



60,000-KW SUPERPOSED TURBINE takes steam at 1450 psig, 1050 F, and exhausts at 280 or 410 psig. Two external steam chests tie into flexibly mounted nozzle chambers. Bleed steam taken off at 10th reaction stage. Turning gear for two speeds

nozzles utilize 18-8 stainless-steel material.

With inlet steam at 1450 psig and 1050 F the turbine will exhaust at either 280 psig or 410 psig to the low-pressure turbines in the main station.

Hydrogen-cooled generator is fitted with integral fans and hydrogen coolers. At 0.5-psig hydrogen-pressure, generator's rating equals 75,000 kva. With 15-psig pressure, generator rating rises to 86,250 kva. Unit has direct-connected main and pilot exciters.

Special design consideration will enable the manufacturer to ship the turbine assembled for direct placement on our foundation.

A 2-speed motor-driven turning gear revolves the rotor at low speed during starting and stopping to minimize distortion from uneven heating and cooling. At 2.5 rpm it has ample power to start the turbine from rest. The high speed of 35 rpm gives the shaft enough velocity to establish an oil-film lubrication and conduct heat from the shaft.

Topper Steam and Water Cycle

Because of expansion problems the superheater-outlet header splits into two parts. Each header, anchored at its center, expands toward the ends. From each of these two headers, two 10-in. main steam leads take the steam to a point near the turbine inlets. Here the four 10-in. lines pair into two 14-in. leads, which connect to a turbine throttle valve. The 10-in. lines, made of Croloy 2¼, are 1.68 in. thick. Final design and layout of the main steam piping was determined with the aid of model testing carried on by M W Kellogg Co, see POWER, Aug 1950, p 124.

After some investigation the "Kelcaloy" type of joint was chosen to tie the Croloy 2¼ piping to the 18-8 stainless-steel throttle valves. This transition piece consists of a center core of 2¼ Croloy, over which is cast a layer of 18-8 stainless steel.

Exhaust steam from the turbine leaves through a 30-in. line running over the bridge and tieing into both the 275- and 400-psig station headers. Some of the exhaust steam stays in the Annex for feed heating and running a turbine-driven boiler feed pump, two other pumps are motor driven.

Quick Starting. To "quick start" the turbine, steam must be supplied at a temperature equal to that of the turbine inlet casing. To attain the average expected temperature after a shutdown the boiler must generate about 300,000 lb per hr. Until the casing temperature level is reached the steam must be bypassed into the turbine's exhaust system.

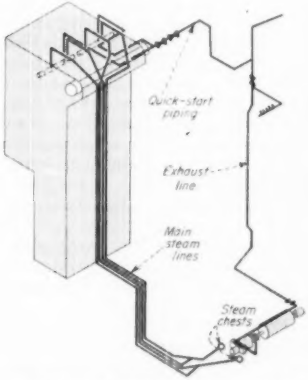
Two 8-in. lines carry the bypassed steam from the superheater's outlet headers. They tie together, as shown in the sketch below, into a 6-in. line fitted with motor-operated 6-in. gate and 6-in. globe reducing valves. The steam is desuperheated to 720 F before entering the turbine's exhaust system.

Condensate System. Condensate returns to the new boiler from the existing station in two separate lines, one "hot" and one "cold." All the boiler feed risers in the main station feed the 12-in. hot line. These taps are made after the high-pressure heaters that supply pure condensate at about 260 F. The normal boiler-feed pressure forces this condensate over the bridge into the Annex's heaters, see heat-balance sketch below.

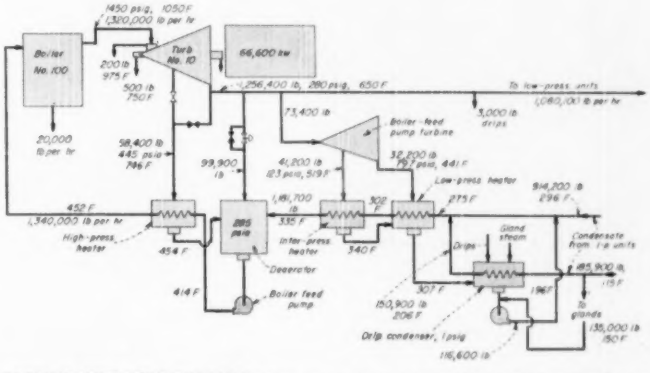
Water first enters a low-pressure 95-psig closed heater taking heating steam from the boiler feed pump's turbine exhaust. Next, the water enters an intermediate-pressure 138-psig closed heater taking steam from a bleed point on the boiler feed pump's turbine. Condensate then enters a 275-psig deaerating heater where it rises to 413 F, heated by steam from the topping turbine's exhaust.

Deaerated condensate enters the boiler feed pumps, two motor driven and one steam driven. Normally one electric and one steam pump operate, the other being a spare. The boiler feed flows through a 400-psig closed heater, taking extraction steam from the high-pressure turbine, and enters the economizer at 450 F.

The "cold" condensate is used for cooling water and for condensing turbine-gland-seal steam. This water comes through a 6-in. line from all the hotwell pump discharges in the main station. The header feeds condensate booster pumps in the main station, which passes this 100-F water over the bridge to the Annex. Here



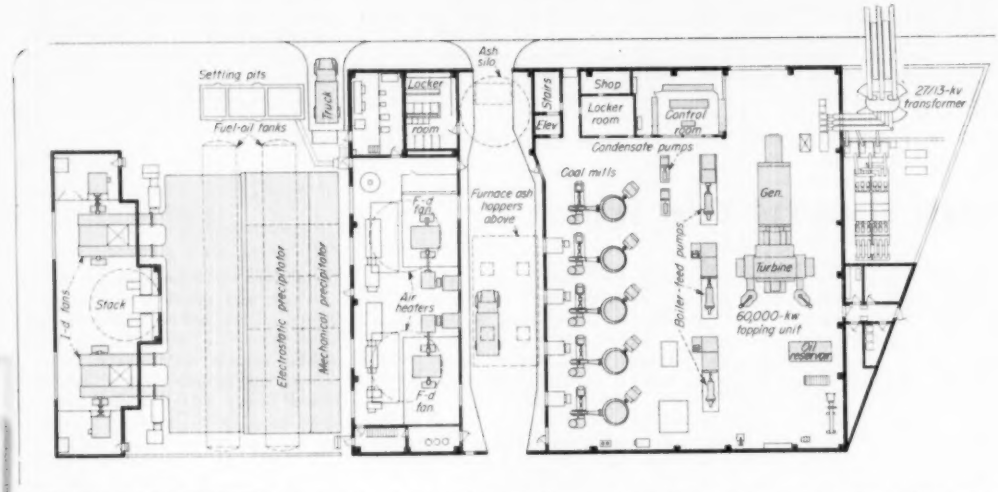
MAIN STEAM PIPING consists of four 10-in. leads merging into two 14-in.



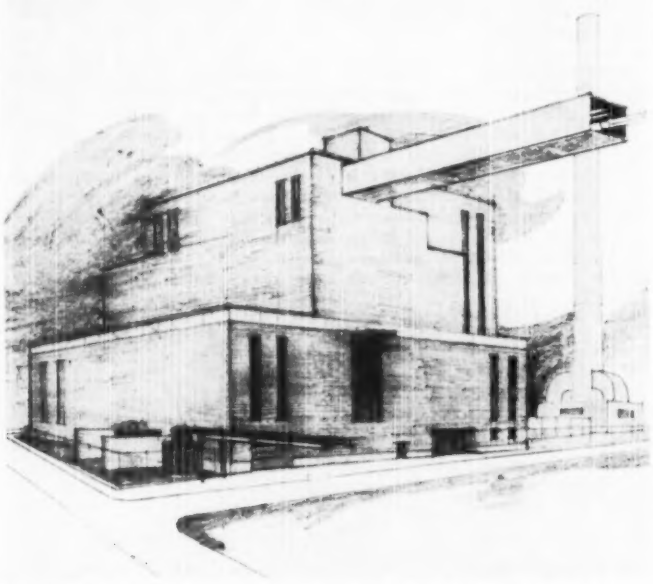
TOPPING-UNIT HEAT BALANCE takes steam from main turbine bleed and exhaust, boiler feed pump's turbine bleed and exhaust for feedwater heating and deaeration

Turn page for more data

Separate Building Houses Superposed Unit...



OPERATING FLOOR OF ANNEX is at ground level. Note close location of coal pulverizers, boiler feed pumps, main topping turbine and central control room for boiler, turbine. Central driveway for trucks picking up ash from boiler hoppers



HUDSON AVE ANNEX housing topping unit will have no windows, only ventilating air openings. Precipitators are outdoors, i-d fans housed at base of plant stack

it ultimately enters the main condensate stream.

A zeolite water-softening plant will provide treated makeup for both the new unit and the present station. Treated water will enter through spray pipes in the existing main condensers.

The Annex building has concrete spread footings, a structural steel frame and 12-in.-brick enclosing walls. The smooth red-face brick matches closely the exterior of the present station. John Street forms a complete separation between the main station and the Annex.

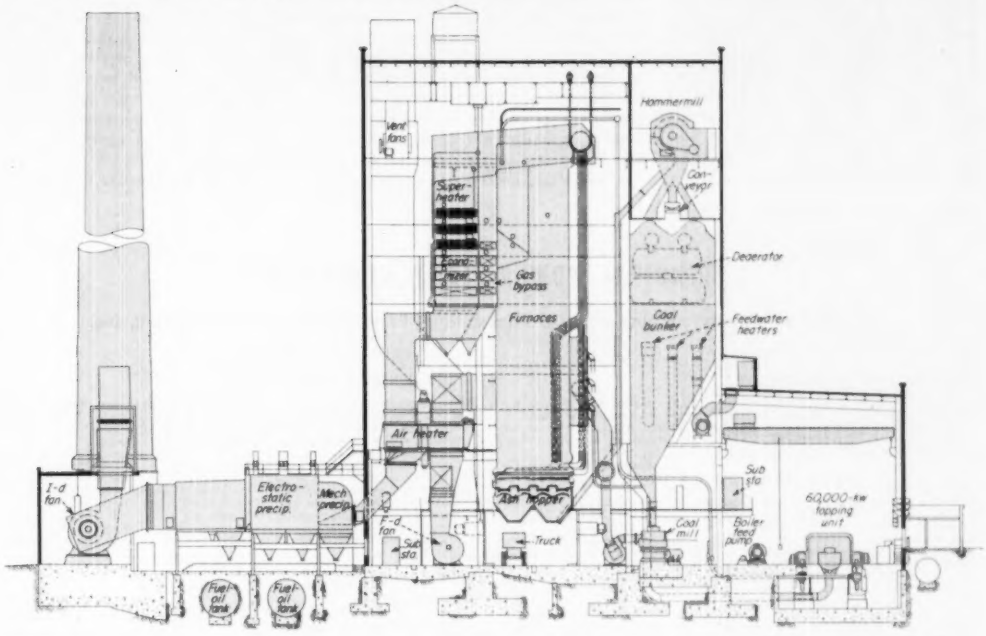
To prevent noise transmission and eliminate sash maintenance no windows are provided in the Annex, as shown in sketch at left. Exhaust fans will limit ventilating air temperature to 15-F rise. Air intake openings with adjustable aluminum louvres, shown in sketch, will give good air distribution. Sound mufflers may be installed at these openings in the future, if they are needed.

Two enclosed stairways will extend from street level to roof. These have closed risers, feralun treads and pipe railings. Auxiliary stairs have grating treads with bent checkered plate nosings. Building roofs are of precast concrete plank topped with 5-ply membrane waterproofing with gravel finish.

Buff brick with a 6-ft-high dark iron-spot brick dado will face the interior walls at each main floor level. Main operating floors are of concrete with troweled granolithic finish. Steel grating forms intermediate floors.

Control Board. Placing boiler and turbine control boards in one control center eliminates fixed-post operators and minimizes the roving operating crew. Control room on the turbine-

...With Only Precipitators Exposed Outdoors



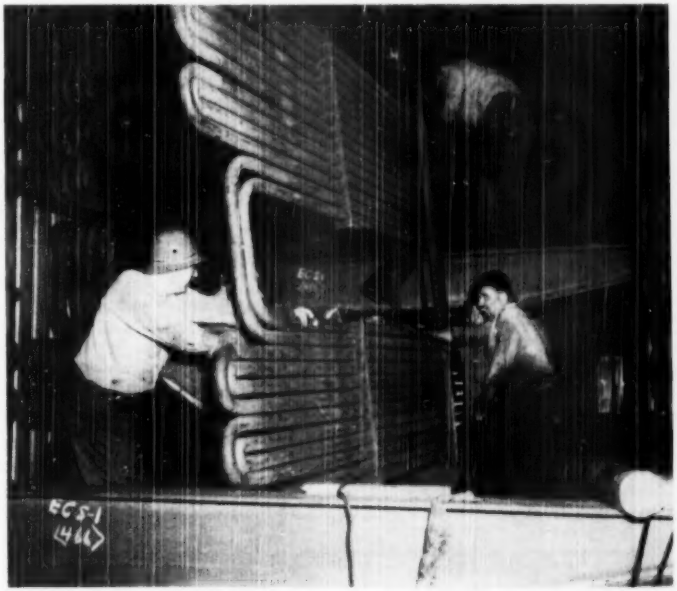
EQUIPMENT SETUP aims at one-floor operating arrangement with all equipment except precipitators under cover. Coal enters Annex at hammer-mill level from main station via belt conveyor. Ash leaves via trucks under boiler hoppers

boiler operating floor, see plan, p 116, has a vertical board in the front with instruments for the boiler and its major auxiliaries. In front of this board a benchboard contains the controls.

At the right stands a vertical control board for running the turbine and its major auxiliaries. This includes the hydrogen panel for generator cooling. On the left, another vertical panel contains miscellaneous auxiliary controls, soot-blower panel, valve controls for remote operation.

With more and more concentration of responsibility on one central operator, increasing reliance must be placed on alarm systems. Extensive use has been made of annunciators for both boiler and turbine equipment. These include a multipoint alarm system on boiler and superheater tube temperatures, a group of five 25-point alarm monitors for auxiliaries bearing metal temperatures. Thrust-bearing metal temperatures on the main turbine are recorded and also supervised by alarm.

The main unit trips out on either excessive thrust-bearing temperature, excessive vibration or low oil-reservoir level. To aid supervising and controlling boiler-drum water level, a utili-



INSTALLING MAIN ECONOMIZER in main gas pass below horizontal superheater. This view gives an idea of the vast size of the mammoth high-pressure steam generator

Turn page for more data

scope television camera, plugging in at either end of the drum, views the gage glass and transmits the picture both to a monitor on the boiler control board and at the feedwater regulator valve.

All the boards were prefabricated and completely wired and piped before delivery. At the station it was only necessary to make connections between station and board terminals for piping and wiring, saving much time.

Careful designing aimed at reducing unskilled manual plant labor to a minimum. Mill rejects go to a storage box on each mill. Once each watch they are sluiced to the settling pit. Short downtakes between bunker outlet gates and mills have an outward taper. This feature is expected to eliminate coal hangups, ratholing, and so on, and also to avoid labor to keep the coal flowing.

By making the flyash-removal system completely automatic and providing large storage capacity and ash hoppers, frequent attention will not be needed.

Authorization for the project was issued in May 1948 and ground broken in April 1949. Initial operation is expected about Jan 1, 1951 for the boiler, and in March 1951 for the turbine.

PRINCIPAL POWER-PLANT EQUIPMENT

Hudson Avenue Station, Unit No. 10, Consolidated Edison Company of New York, Inc

STEAM-GENERATING EQUIPMENT:

Boiler, 1 — Babcock & Wilcox Co
Divided furnace, dry bottom, 1,370,000 lb per hr continuous capacity, 1450-psig 1050-F steam at superheater outlet. Furnace and boiler heating surface 21,585 sq ft, superheater 50,300 sq ft, economizer 68,000 sq ft, regenerative air heaters 354,000 sq ft

Pulverizers, 5 — Babcock & Wilcox Co
Mills feed 16 burners arranged in three horizontal rows in front of twin furnace

Pulverizer drives, five 150-hp 440-v motors — Allis-Chalmers Mfg Co

Mill-fan drives, five 150-hp 440-v motors — Allis-Chalmers Mfg Co

Mill-feeder drives, five 2-hp motors — Louis Allis Co, Inc

Dust collector, 1 — Western Precipitation Corp
Combined mechanical-electrical, 97% effy at 577,000 cfm and 270-F temp. 1212 multiclone 9-in.-dia collectors in primary section.
Second section has dual plate and pocket electrode collectors.
Five parallel compartments with shutoff dampers automatically controlled by automatic rapping sequence

Ashpit handling — Chicago Fire Brick Co
Four main hoppers, corrosion-resistant steel, dump into motor trucks beneath boiler. Two upper hoppers open into each main hopper, salt-water quenching, continuous drains carry off water and fine ash, water seal allows independent movement between hoppers and boiler, hydraulically operated gates

Flyash handling — United Conveyor Corp
Pneumatic type, 25 tph with loading points at dust collectors, flue hoppers, economizer and stack hoppers, discharge into 17,400-cu-ft silo, air-operated intake valves at hoppers, 6- and 7-in. conveyor piping

Flyash-system vacuum pumps, 2 — Nash Engineering Co
Ni-resist casing, model shaft, 263 rpm

Flyash vacuum-pump motors, 2 — Westinghouse Electric Corp
100-hp 440-v 1200-rpm, V-belt drives

Flyash conditioners, 2 — Chicago Fire Brick Co
40 tph, 38-in.-dia steel rotating drum, rotary feeder

Flyash conditioner motors, 2 — General Electric Co
7½-hp 440-v geared motor driving drum; 2-hp 440-v motor turning feeder through chain drive

Induced-draft fans, 2 — Sturtevant Div, Westinghouse Elec Corp
Double width, double inlet, radial-tip blades, inlet-vane control, 350,000 cfm each with 300-F gas, 16.3-in. water press., at 580 rpm

Induced-draft-fan drives, 2 — Allis-Chalmers Manufacturing Co
1250-hp 440-v 600-rpm motors

Forced-draft fans, 2 — Sturtevant Div, Westinghouse Elec Corp
Double width, double inlet, backward-curved blades, inlet-vane control, 200,000 cfm, 90-F air, 11.0-in. water press., 883 rpm

Forced-draft fan drives, 2 — General Electric Co
450-hp 440-v 900-rpm motors

Recirculating fans, 2 — Sturtevant Div, Westinghouse Elec Corp
Double width, double inlet, for gas recirculation in steam temperature control, 43,000 cfm, 610-F gas, 6.5-in. water press., 875 rpm. Manual control through Hagan operators

Recirculating-fan drives, 2 — General Electric Co
75-hp 900-rpm 440-v totally-enclosed fan-cooled induction motors

Safety valves, 8 — Foster Engineering Co
4 on drum, 2 on superheater, 2 on main steam

Soot blowers, 20 — Vulcan Soot Blower Corp
Steam blow, air powered and controlled, 10 semi-retractable in economizer, 4 retractable in primary superheater, 4 retractable for secondary superheater, single mass blower in each air heater
Manual or automatic sequential blowing from control room

Regenerative air heaters, 2 — Air Preheater Corp
177,000 sq ft each, basket elements in three layers for convenient removal and cleaning

Remote drum-level indicators — Yarnall-Waring Co

Television viewers, 2 — Diamond Power Specialty Corp
Drum level at control room and feedwater regulating valve

Chemical feed pumps, 4 — Milton Roy Co
Two simplex motor-driven units for sodium phosphate, 48 gph at 2000 psig. Two duplex motor-driven units for sodium hydroxide, 66 gph at 600 psig

Combustion control — Hagan Corp

Feedwater control, 3-element — Bailey Meter Co

Superheat control — Bailey Meter Co
Superheater and bypass damper operation, responding to steam temperature and air flow

Coal-handling system — Chain Belt Co
Receiving hopper fed from existing coal road, feeder, 600 tph, 500-ft-long belt, 48 in. wide, Bradford breaker, hammer mill, 600-tph reversing belt conveyor, 48 in. wide, distributing to bunkers

Chutes, magnetic pulleys, etc — Magnetic Engineering Co

Coal-handling motors, 4 — Westinghouse Electric Corp

POWER-GENERATION EQUIPMENT:

Turbine-generator, 1 — Westinghouse Electric Corp
60,000 kw, 0.8 pf, 75,000 kva, 3 phase, 60 cycle, 13,800 v, 3600 rpm. 2 impulse, 14 reaction stages, throttle steam 1450-psig and 1050-F, exhaust at 280 psig. 10th reaction stage bleed at 430 psig

Turning gears, 2 — Westinghouse Electric Corp
Low-speed gear, 4-rpm 15-hp 1750-rpm motor. High-speed gear, 28-rpm 10-hp 1160-rpm motor

Lubricating systems — Westinghouse Electric Corp
Main pump mounted on main turbine shaft, 1000 gpm, 125 psig. Steam-driven auxiliary pump, 450 gpm, 75 psig, 3600 rpm

Hydrogen cooling system — Westinghouse Electric Corp
1900-cu-ft volume in generator casing, 60,000-cfm circulation by integral shaft fans

FEEDWATER EQUIPMENT:

Boiler feed pumps, 3 — Byron Jackson Co
Double casing, 9 stages, 750,000 lb per hr, 300 psig, 414 F at suction, 1980-psig discharge, 3585 rpm

Boiler feed pumps' drives, 3 — General Electric Co
Two 2250-hp 440-v 3-phase motors. One 2273-hp 3585-rpm noncondensing steam turbine

High-pressure feedwater heater, 1 — American Locomotive Co
Closed type, 1,320,000-lb-per-hr water flow, 56,000-lb-per-hr of 422.5-psia steam flow

Intermediate-pressure feedwater heater, 1 — Struthers Wells Corp
Closed type, 1,250,000-lb-per-hr water flow, 61,500-lb-per-hr of 182-psia steam flow

Low-pressure feedwater heater, 1 — Struthers Wells Corp
Closed type, 1,120,000 lb-per-hr water flow, 68,800-lb-per-hr of 103 psia steam flow

Deaerating heater, 1 — Elliott Co
1,500,000-lb-per-hr water flow, 67,000-lb-per-hr of 103-psia steam flow

Drip condenser, 1 — Struthers Wells Corp
284,000-lb-per-hr feedwater flow, 29,800-lb-per-hr of 1.47-psia steam flow

Desuperheaters, 2 — Republic Flow Meters Co
One for 650,000-lb-per-hr steam flow with discharge temperatures of 750 and 612 F. One for quick starting flow of 300,000-lb-per-hr flow of steam at 720 F and 290 psig to main line

Heater drain pumps, 2 — Byron Jackson Co
Four-stage centrifugal, 400 gpm, 400-psig delivery

Heater drain-pump drive, 2 — Allis-Chalmers Mfg Co
150-hp 440-v 3-phase 3550-rpm motors

Sealing-water return pump, 2 — Ingersoll-Rand Co
100 gpm, 85-ft total dynamic head

Sealing-water pump drives, 2 — Westinghouse Electric Corp
5-hp 440-v 3-phase 3600-rpm motors

Condensate booster pumps, 2 — Byron Jackson Co
750 gpm, 450-psi total delivery head

Condensate booster-pump drives, 2 — General Electric Co
250-hp 2300-v 3-phase 3600-rpm motors

MISCELLANEOUS EQUIPMENT:

Barometric condensers, 2 — Schutte & Koerting Co
One 550-lb-per-hr blowdown condensed to 123 F with 250-gpm of salt water. One for mass blowdown of 24,000 lb per hr condensed to 157 F with 600 gpm of salt water

Level and pressure controllers — Fisher Governor Co

Condensate-pressure controller — Fisher Governor Co

Acid-washing pump, one, 475 gpm, 85-ft head — Duriron Co

Acid-pump drive, one, 25-hp 440-v 1800-rpm motor — General Electric Co

Salt-water pumps, 3 — Ingersoll-Rand Co
Single-stage, 3500 gpm, 200-ft total head

Salt-water pump drives, 3 — Allis-Chalmers Manufacturing Co
250-hp 2300-v 3-phase 1200-rpm motors

Fuel-oil pumps, 2 — Sier-Bath Co
Screw type, 300 gpm, 210-psig total head

Fuel-oil-pump drives, 2 — Westinghouse Electric Corp
75-hp 440-v 3-phase 1200-rpm motors

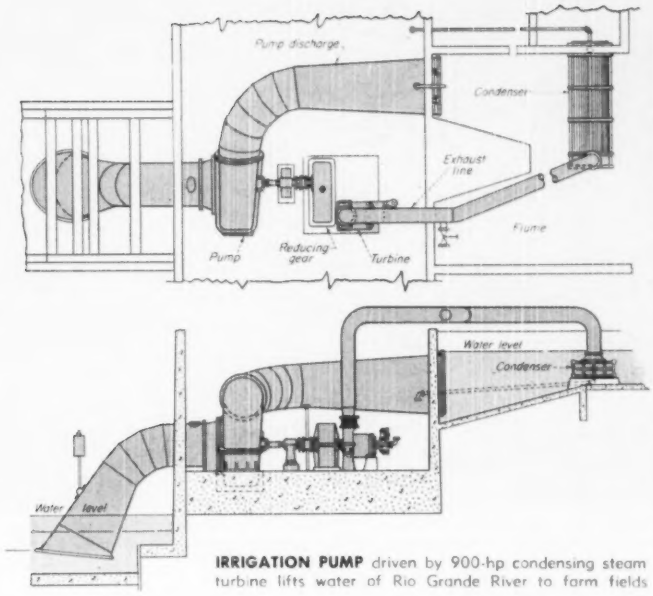
Safety valves — Manning, Maxwell & Moore, Inc; Crosby Steam Gage & Valve Co; J E Lonergan Co

Fuel-oil storage tanks, two, 90,000 gal each — M H Treadwell Co

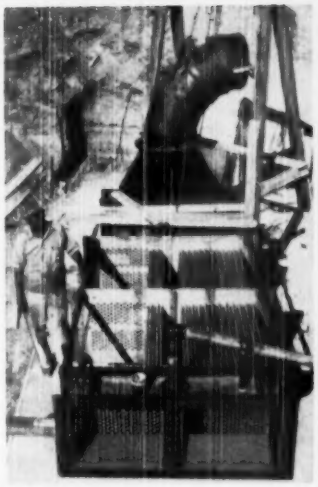
Main air compressor — Chicago Pneumatic Tool Co
913 cfm at 100 psig, 300 rpm, 200-hp synchronous-motor drive

Emergency air compressor — Chicago Pneumatic Tool Co
115 cfm at 100 psig, 870 rpm, 25-hp induction-motor drive

Turbine-room crane — Shaw-Box Div, Manning, Maxwell & Moore, Inc
35-ton main hoist, 10-ton auxiliary hoist, 56-ft span



IRRIGATION PUMP driven by 900-hp condensing steam turbine lifts water of Rio Grande River to farm fields



CONDENSER for turbine exhaust steam is shown under construction on bed of irrigation canal. Steam and condensate pass within tubes, box headers and pipe, top. Water flows over tube exteriors

Sink 'Inside-Out' Condenser in Canal

Condenser without shell reverses usual procedure by condensing steam within its tubes. Tube assembly is submerged in canal water acting as the needed cooling agent

By B STANLEY NELSON
Chief Engineer, A M Lockett & Co, Ltd

► THE AREA AROUND the lower 100 miles of the Rio Grande has rich farming soil. Sparse rainfall makes it necessary to irrigate this soil with river water. In most locations the water must be lifted twice, first about 25 ft, then relifted some miles away through another 18 to 20 ft.

Some of the pumping plants have been running over 40 years. Their prime movers have run the gamut of developments in the power field. These include reciprocating steam engines fed by wood-burning boilers. Later these were converted to oil firing. There are also electric motor-driven pumps taking their energy from high-tension lines. Internal-combustion engines of both oil- and gas-burning types represent later installations.

River Plant. About three years ago the River Plant required an increase in capacity. This steam-engine driven plant had two old 36-in. and two old 60-in. pumps. The small units were in poor condition, but the large ones were in good shape.

After studying all factors it was decided to replace the two small units with a single 60-in. pump. The new pump would be installed in the existing pit housing the small units. This did not leave enough room to accommodate a 1000-hp gas-burning internal-combustion engine to drive the pump. On the other hand, there was enough room to install a condensing steam-turbine drive.

The new unit selected was a Worthington single-suction mixflo pump, direct-connected through double-helical reduction gears to a 900-hp condensing steam turbine. Unit delivers 110,000 gpm against 26-ft total head at 250 rpm with an efficiency of 84%. A 3-drum gas-fired Babcock & Wilcox water-tube boiler supplies steam at 200 psig and 75-F superheat to the turbine.

Turbine exhausts to a "flume condenser" of special design, which maintains a backpressure of 2-in. Hg abs. The flume condenser may be considered an inside-out arrangement. It has two cast-iron or steel head boxes held apart by distance pieces. Conventional brass condenser tubes in brass tube sheets in each head box form the condensing surface, see photo above. The condenser is submerged in the irrigation water at the discharge of the pump. Steam enters at top of one head box and the condensate drains off at bottom of the other. The canal cooling water flows over the exterior of the tubes at right angles, see sketches above.

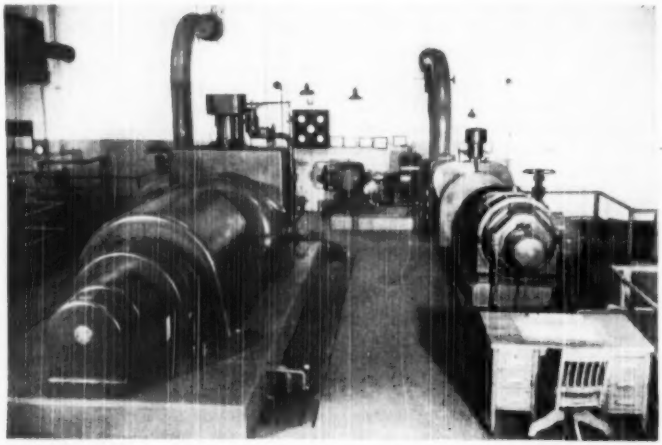
A standard shell-and-tube condenser would quickly become fouled with mud and small debris from the river water. Aside from the improved thermal efficiency, bad makeup water makes a surface condenser highly desirable to recover good feedwater. Condensate pumps back to a deaerating feedwater heater delivering at 215 F. Turbine bleed steam automatically maintains a pressure of 3 psig in the heater. Boiler steam conditions were chosen so that after pressure reduction no desuperheating would be needed for use in the old pump-driving engines.

INDUSTRIAL CENTER has 30 buildings with a total of more than a million sq ft of floor space. Heavy industries are located on lower floors, light ones on upper floors. Power plant supplies electricity and steam for manufacturing, space heating

How One Plant Serves 40 Industries

By **COMDR WILLIAM J ROTH Jr,** *Engrg Asst to President, Engelhard Industries*

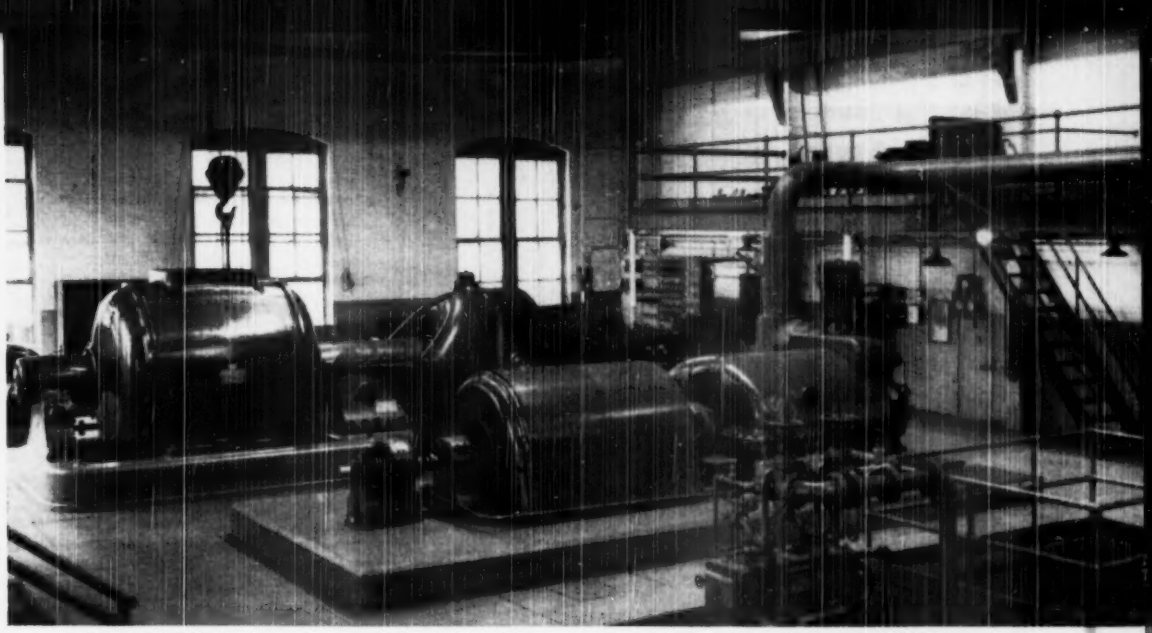
East Newark Industrial Center provides reliable and economical steam and power services to industrial manufacturers. Modernization of generating facilities, good operation give top-notch, round-the-clock service in this unusual plant



TURBINE ROOM. Two of the three new units are shown here. Unit at *left* is 2000-kw single-extraction condensing. Small unit, *right*, is rated at 300-kw, noncondensing

► THE JOB OF PROVIDING steam and electricity 24 hours a day, seven days a week to 40 manufacturing firms is not an easy one for an industrial power plant, but that's the task performed by East Newark Realty Corp—one of the Engelhard Industries. We're mighty pleased with results and so are our tenants in the East Newark Industrial Center, East Newark, N. J., the group of buildings we serve.

This was once the plant of Clark Thread Co. We took it over in 1935 and began reconditioning and modernizing it for rental to manufacturers desiring convenient facilities with power and maintenance services available. We are still improving our power-plant setup to render even better service and meet growing load demands. Before going into details on this program, let's take a look at the over-all picture of our operations—what we offer our tenants at the Center.



STANDBY TURBINE is older unit near outside wall of building. This unit is rated at 2000-kw and exhausts to a barometric condenser. Newer turbine in foreground is 1500-kw condensing. The new turbine was installed on an existing foundation

Industrial Center. We have 30 buildings with a total of more than a million sq ft of floor space. This space is rented to textile dyers, cleaners, garment manufacturers, electrical, radio, television, machinery, metal and heavy industries. Tenants' rent pays for floor space, but steam, electricity, water, watchmen's service, and heat are billed separately. In other words, we supply tenants everything in the way of manufacturing space and utilities except the machines used for manufacturing.

Besides power and steam we run piping and conduit to each plant, have a week-round maintenance crew on the job and are ready to perform all usual and many unusual jobs. Watchmen guard all premises.

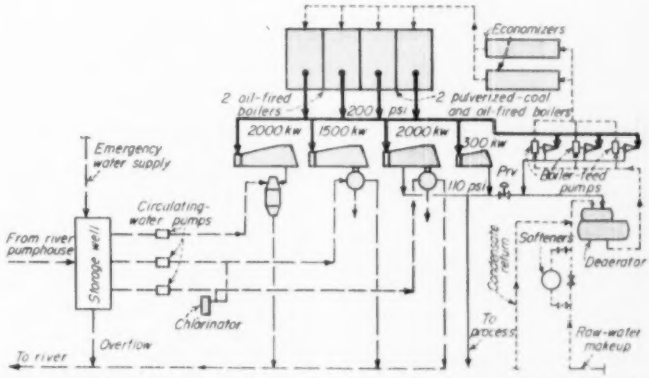
Our main buildings are brick, mill-type construction. The ceiling heights range from 13 ft 6 in. to 30 ft. Single floors vary in area from 5000 sq ft to 57,500 sq ft. We use mostly unit heaters for building heating.

Tenants using large, heavy machines locate on ground floors; lighter machines go on upper floors. Our localities favor heavy steam and power users, though we have tenants who are heavy in only one demand. Small users of power have a retail rate, large a wholesale rate. Attractive rates during night periods are also provided for large users. Located in an area served by a progressive public utility our electric rates must be comparable.

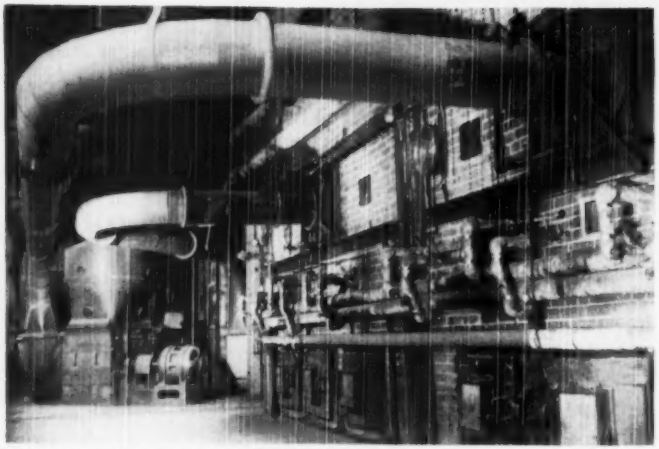
Because we can burn different fuels our steam rates are most reasonable. Rates for tenants vary with capacity desired and investment needed for distribution lines, meters and other equipment. We have a flat rate for small users while for large ones a conventional stepdown rate is available. With this the greater the use of steam, the lower becomes average cost to tenant. Rates contain adjustment clauses to provide for fluctuation in fuel prices and labor costs.

Power Plant. Flexibility and dependability keynote our power facilities. Our boilers, diagram below, burn either coal or oil delivered by truck or barge. In this way a ready supply of fuel is assured during almost any eventuality which arises locally or nationally. Such a combination also gives purchasing agent bargaining power in his selection of a fuel supplier. Boiler house contains two combination pulverized-coal and oil boilers and two oil-fired boilers.

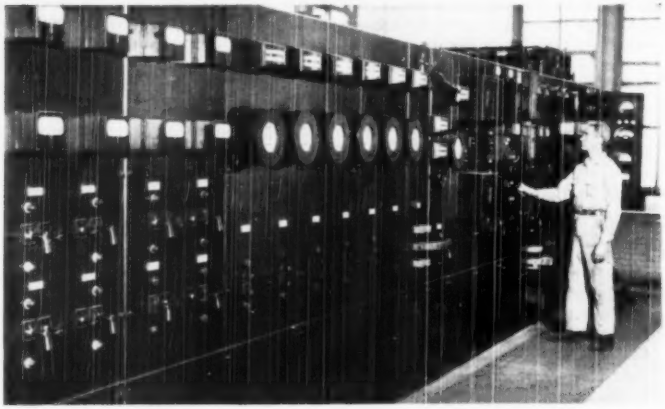
When we took over this group of buildings in 1935 from the Clark Thread Co the plant had three turbines. Ratings were 6000, 3000 and 2000 kw, all condensing. They were not operating. Since these units were built before 1917 we replaced all except the 2000-kw. It was reconditioned and is now used for standby service. A 2000-kw extraction unit, 300-kw noncondensing,



FLOW DIAGRAM shows principal equipment used for supplying power and steam to the industrial center. Condenser cooling water and water-treatment circuits also shown



OIL AND PULVERIZED-COAL FIRED BOILERS supply part of steam for power generation. Two other boilers, not shown, burn oil only and share load with these units



ELECTRIC SWITCHBOARD shows plant development. Center section has older equipment; left and right sections are newer. Plant switchgear is in a separate room below

and a 1500-kw condensing unit replace the older turbines.

In selecting total electrical capacity we had to keep in mind the importance of dependable service, economical operation and demands of different factories. We evaluated expected kw demand from all ground-floor areas serving heavy industries, expected kw demand from multiple-story buildings serving light industries, peak-load diversity factor and extra electrical loads during darker winter days when more lights and several hundred unit heaters are used. Analysis showed that a capacity of about 4000 kw would serve the expected electrical load. Also, this load was most desirable from an economic standpoint.

Maximum steam capacity was selected by analyzing loads in a similar manner. We found that 90,000 lb per hr was maximum to expect for process work and building heating for the different industries.

Steam generated at 200 psi in the pulverized- or oil-fired boilers supplies these turbines. Extraction at 110 psi from the 2000-kw unit furnishes heat for tenants' process loads. We also supply process steam at any pressure up to 200 psi. For higher pressure, tenant must use a steam compressor.

Process condensate is returned to boiler house if it is to be reused. Where there's any chance of oil or acid contamination we discharge condensate to sewer. There hasn't been any trouble with contamination.

The 2000-kw extraction unit carries base load. We can extract 70,000 lb per hr of steam from it. The 1500-kw condensing unit takes peak-load swings during the day and the 300-kw unit augments power or process-steam supply when demand exceeds extraction capacity. With this combination we can economically meet any steam demand up to 112,000 lb per hr and electrical demands up to 4000 kw.

Water Supply. Passaic River water is used for condenser cooling. Intake screen and rotary strainer prevent solids entering. Pumphouse at river edge delivers water through 800 ft of pipe to a well adjacent to power plant. From here it is picked up by circulating pumps and passed through condensers.

Automatic-intermittent chlorination of cooling water prevents accumulation of bacteria and algae. Before installation of this system we had to clean condenser tubes every three weeks during summer. We now clean them only twice a year.

Makeup and drinking water comes from the Passaic Valley Water Commission, which is supplied from a reservoir and the river. Two automatic zeolite softeners treat all makeup. From softeners makeup goes to a tray-type deaerator. In addition, all boilers receive internal chemical treatment daily to remove any residual hardness.

Electrical System. All power is generated at 600 v, 3 phase. Nine substations are located at various load centers in the buildings. At these the voltage is stepped down to 120/208 v except for those industries needing 600-v service.

To prevent interruptions of power service by wind, snow or ice storms all distribution lines from power plant to substations run underground. Spare underground ducts, cables and distribution transformers throughout plant keep outage time to a minimum. Voltage is regulated at power plant and can also be adjusted at load centers by moving taps on distribution transformers.

To improve turbine-room visibility we recently installed high-bay mercury-vapor lights. These are supplemented by conventional wide-angle incandescent reflectors. Use of mercury-vapor lighting greatly increases illumination level of turbine room, gives it a smart appearance, is liked by our operators.

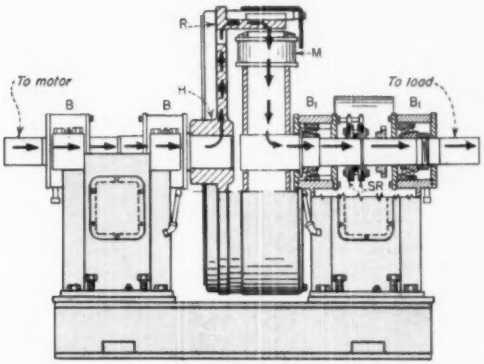
Controlling frequency so electric clocks, timing devices, etc, operate satisfactorily was solved by a Telechron master clock. Accuracy of master clock is maintained by a daily radio check with time signals from the U.S. Naval Observatory, Arlington, Va.

(Continued on page 210)

ELECTRONICS FOR THE POWER ENGINEER

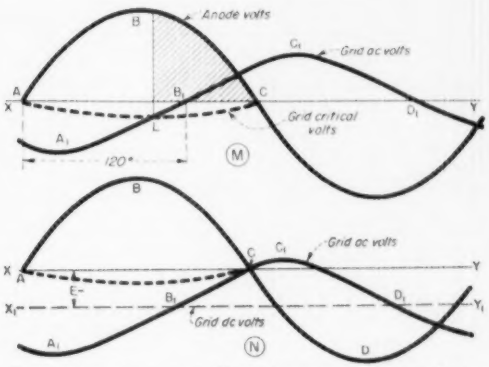
By F A ANNETT, *Associate Editor*

Magnetic Drive and . . .



1 Cross section through variable-speed magnetic drive. The heavy arrows show the power flow from the motor to the load

Anode and Grid Voltages



2 Anode, grid voltages. *M*: grid and anode volts 120 deg out of phase. *N*: minus dc bias applied with grid ac voltage

31—Magnetic-Drive Control: Part I

► A MAGNETIC DRIVE with electronic control is one of several ways to obtain adjustable speed when using ac power. Such equipment gives precise, wide-range quick-response speed control. Operating speed of the driven load can be held to within plus or minus 0.5% of the selected value, regardless of reasonable changes in load or line voltage.

Magnetic Drive. Fig. 1 shows one design of such a drive. It consists of a solid steel ring *R* on a hub *H*, the shaft for which is supported in two bearings *B*, and connects to the driving motor. The rotor or magnet has poles *M* similar to the rotor of a synchronous motor without damping windings, mounted on a shaft that runs in two bearings, B_1. This shaft connects to the driven load. Magnet coils are excited with dc supplied through brushes that ride on sliprings on the output shaft.

When these coils are excited and the ring rotated, torque is transmitted from ring to magnet in the same way as from stator to rotor of an induction motor. In larger designs of the same make of drive the outer drum has a laminated core and squirrel-cage winding.

With full excitation in the magnet coils and driving full load, output speed is about 3% less than input. By adjusting field current, output speed can be regulated from about 97% down to 15% of driving motor's full speed. Excitation is adjusted manually or by other method, including electronic control.

Electronic Speed Control. Fig. 3 is a simplified diagram of an Electric Machinery Mfg Co's Regutron for electronically adjusting output speed of magnetic drives and holding the speed constant at any setting of the control potentiometer *MP*. This control looks a little complicated but is quite simple when a few of its features are explained.

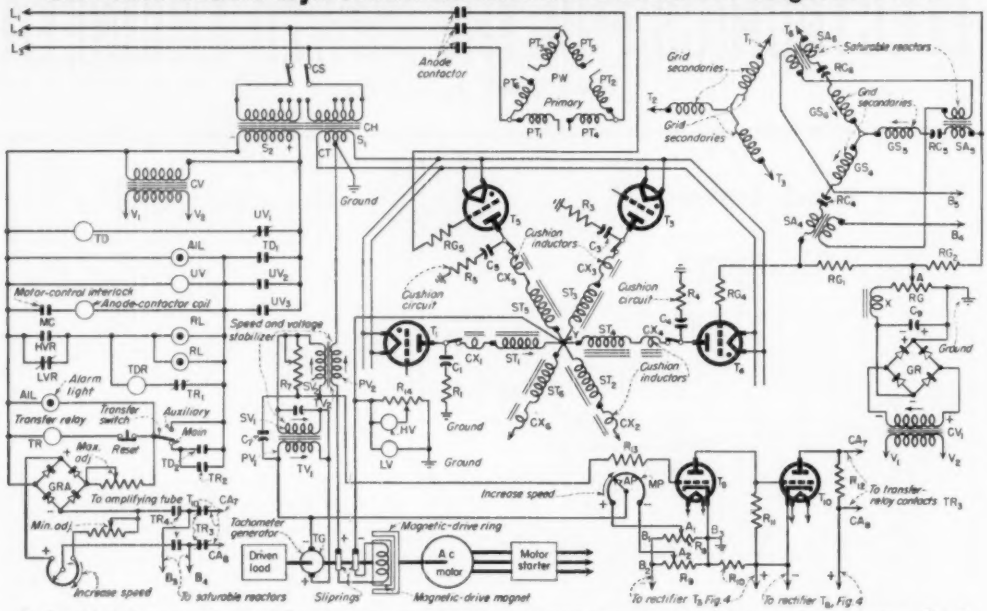
Exciting current is supplied to the magnetic drive's field coils by a 6-phase rectifier consisting of gas-filled tubes T_1 to T_6. These tubes, through their transformers' secondary windings ST_1 to ST_6, connect in double wye. Primary windings of the rectifier's transformer *PW* are connected in delta.

Winding ST_1 is the secondary of primary PT_1. Both windings occupy the same phase position. Winding ST_4 is the secondary of primary PT_4. Here again the two windings have parallel positions. Also secondary ST_3 corresponds to primary PT_3 and has a similar position. This completes one of the *Y* groupings. The same reasoning applies to secondary ST_6, ST_5 and ST_6 and primary PT_6, PT_5 and PT_6.

Control of rectifier's output is by an ac potential, out of phase with the anode volts and a constant dc bias. Connection for this control is in top right corner of drawing. For simplicity, complete grid-control connections are shown for tubes T_1 and T_4 only. Secondaries GS_1, GS_3 and GS_5 are parts of the power transformer, *PW*. Each secondary is connected in series with a capacitor *RC* and a saturable reactor *SA*.

Saturable Reactor. Earlier in these articles we learned that a saturable reactor was one that had an ac and dc winding on its core. With the dc

Six-Phase Double-Wye-Connected Rectifier Powers the Magnetic Drive



3 Simplified diagram of control for electronically adjusting the output speed of a magnetic drive and holding the speed constant at any setting of the control potentiometer. Drive's output speed can also be adjusted by manual control

coil dead the reactor is the same as one of conventional design with high reactance. When sufficient current passes through the dc coil to saturate core, inductance of ac coil drops to practically zero and it readily passes ac. By varying the current in the dc coil, reactance of the ac coil can be varied from zero to maximum. This device is used in ac circuits for many control purposes. Among them, as part of a phase-shift circuit to control output of gas-filled tubes as in Fig. 3.

Ac Grid Voltage. Assume the voltages at a given instant in secondaries GS_4, GS_5 and GS_6 are as arrows indicated. Then an ac potential is applied to grids of tubes T_4, T_5 and T_6 through capacitor RC_4, saturable reactor SA_4, grid to cathode of T_4, from cathode to grid of tubes T_5 and T_6, back to the grid network through secondaries GS_5 and GS_6 to GS_4. Direction of these grid voltages is continually changing, but the circuit we followed indicated how ac potential is applied to the grids of power rectifier tubes.

Without dc in the control coils of saturable reactors SA_4, SA_5 and SA_6, their ac coils have maximum reactance. Grid network is so designed that ac grid voltages lag the anode volts of the tubes 120 deg, as in Fig. 2*M*. In this figure, curve *ABC* is the anode volts of, say, tube T_4, and $A_1B_1C_1D_1$ is the ac grid bias 120 deg out of phase lagging with *ABC*. Dotted curve *ALC* is the critical grid bias of tube T_4. As long as the grid is held more minus than this curve the tube cannot conduct. In this case the grid's ac voltage curve crosses the critical curve at *L* and the tube conducts for the remainder of voltage wave *ABC*, as indicated by cross-sectional area.

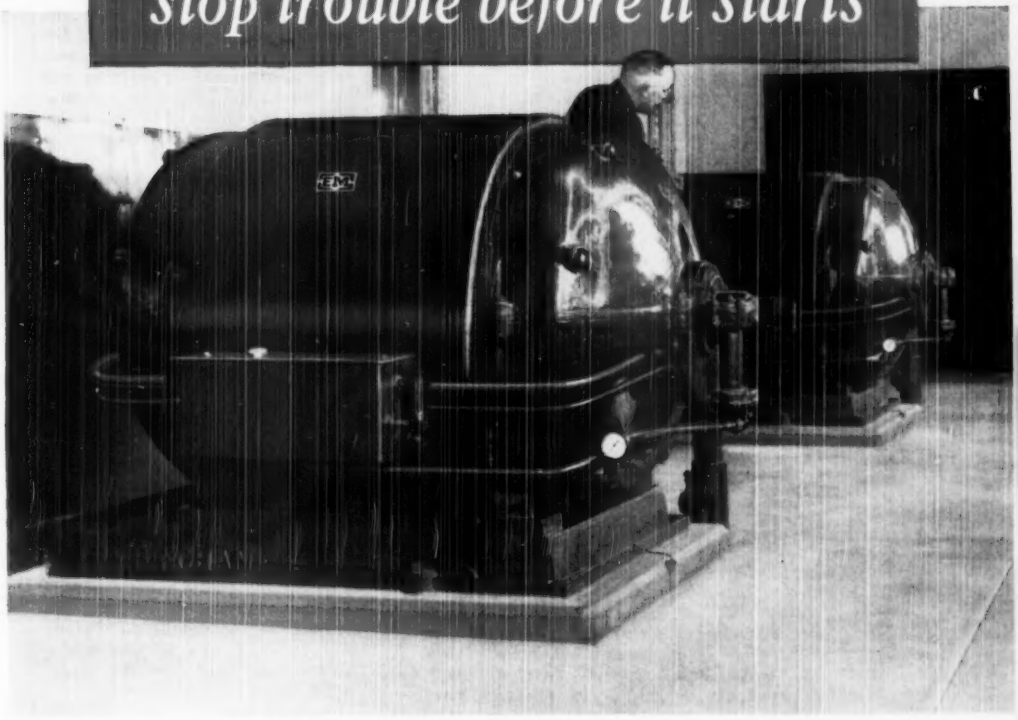
Dc Grid Bias. In addition to the ac potential on grids of tubes T_1 to T_6, a constant dc minus bias is applied from the full-wave selenium-disk rectifier *GR*. Primary terminals V_1, V_2 of transformer CV_1 connect to the secondary of constant-voltage transformer *CV*. Output of rectifier *GR* is filtered by reactor *X* and capacitor C_9, and applied across resistor *RG*.

A dc bias is applied to tube T_4 grid from *A* on resistor *RG*, through RG_1 and RG_4, from grid to cathode of tube T_4 to center tap on secondary S_1 of the cathode-heating transformer to ground, back to ground on *RG*. This applies the voltage between *A* and the ground on resistor *RG* as a minus bias on grid of T_4. Effect of the dc bias is to drop the ac grid voltage as in Fig. 2*N*. In Fig. 2*M* the ac grid-voltage curve crosses the critical curve at *L*. In Fig. 2*N* if the dc bias equal *E*—, it will lower the ac grid-voltage curve to where it cannot intersect the critical and tube T_4 cannot conduct. We can assume that this is the condition when the dc coils of saturable reactors SA_4 to SA_6 are dead, and reactance of the ac coils is at a maximum.

Phase Shift. Reactors cause the grid volts to lag the anode volts, where the capacitors tend to reduce the lag. By passing sufficient dc through the reactor's control coils to saturate their cores, their reactance is reduced to practically zero. Under these conditions the capacitors phase shifts the ac rider to lag the anode volts by about 60 deg, which is sufficient to give maximum output for a 6-phase rectifier. Rectifier output then can be controlled from zero to maximum by adjusting current in the dc coils of the saturable reactors. Increasing current in these coils increases rectifier output, where decreasing the current reduced rectifier output.

Dc Coil Supply. Current in the reactors' dc coils is supplied from transformers PT_7 and PT_8, and rectifier tubes T_7 and T_8 and controlled by tubes T_9 and T_{10}, Fig. 4. Transformers

5 Extra Value Features... *stop trouble before it starts*



1300-TPA-2091

E-M Heavy Duty 2 Pole Induction Motors, 800 hp. drive centrifugal pumps in a pipe line station at Drumright, Okla. Motors are started full voltage through E-M Hi-Fuse Controls.

Let's check the E-M features that stop trouble before it starts, guard against motor troubles and promote continuous operation . . . each a big step toward the elimination of shut-down.

I. Fortifying the Coils against Moisture. The completely wound stator is dipped in a flexible thermo-setting varnish . . . and then baked. Multiple coating and baking provide the type of protection operating conditions require.

II. Vacuum-Pressure Impregnation of the coils on large 2 pole motors with asphaltum insulating varnish. Result . . . finest high-voltage insulation . . . high di-electric strength . . . best seal against moisture.

III. Choice of Flood Lubrication Systems. E-M 2 pole motors using flood lubrication are available with a worm-gear driven pump or a separate motor-operated pump.

IV. Shakeproof Vent Spacers. Laminations of the rotor and stator are separated with vent spacers to provide air cooling of the motor. E-M spot welds these vent spacers . . . and increases this security with a mechanical lock.

V. True, Uniform Air Gap. By mounting bearing brackets above the centerline, E-M compensates for the clearance in journal, shaft and housing fits.

Write for "ABC of Large Induction Motors", the E-M 32-page bulletin that presents important information on big drives.

It will also give you some idea of why Electric Machinery of Minneapolis is known as "Specialists in Big Motor Engineering" and how this *high degree of industrial specialization* pays off for specifiers and users of E-M Big Motors, Generators and Controls.

ELECTRIC MACHINERY MFG. COMPANY
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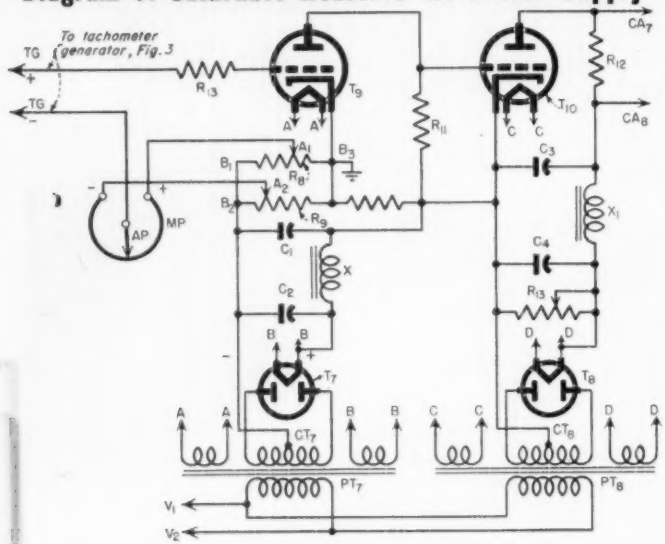
Diagram of Saturable Reactors' Dc Power Supply



4 Current in the reactors' dc coils is supplied from the rectifier tube T_8, and controlled by tubes T_9 and T_{10}, according to the setting of potentiometer *MP*

on these rectifiers are powered from the secondary of transformer *CV* in upper right corner of Fig. 3. Rectifier tubes are dual diodes for full-wave rectification. Ripples in output of the tubes are smoothed out by a pi filter consisting of a reactor *X* connected between two capacitors C_1, and C_2.

Transformers PT_7 and PT_8 have secondary sections *A-A*, *B-B*, *C-C* and *D-D* to supply heating current to cathode of tubes as marked. Current for tube T_8 is from center tap CT_7 on the transformer through resistors R_8 and R_9 in parallel, from cathode to anode of T_8, resistor R_{11} to T_{10} cathode and either anode, depending on transformer polarity. A similar circuit exists for tube T_9, whose output at CA_7 and CA_8 connect through transfer relay contacts TR_8 and leads B_1 and B_3 to the saturable-reactor coils.

Volts' drop across resistor R_{11} is applied as a minus bias to tube T_{10} from top of R_{11} to grid and cathode, to bottom of R_{11}. Varying the current flow through tube T_9 by control of its grid potential can adjust volts' drop across R_{11}. This, in turn, controls bias on T_{10} grid and output of this tube and current through the dc coils of the saturable reactors.

These reactors control output of the 6-phase rectifier to the coils of the magnetic drive, and its output speed, as previously explained, on page 123.

Potentiometer Control. Taps A_1 and A_2 are placed on resistors R_8 and R_9 to provide suitable voltage for the potentiometer speed-control range for the magnetic drive. Current flows through the potentiometer from rectifier—terminal to A_2 through *MP* to A_1, through tubes T_9, R_{11} to + rectifier terminal. If arm *AP* is moved clockwise to the — terminal on *MP*, tachometer generator's voltage is opposed by that between arm *AP* and terminal B_2. As a result minimum voltage is applied from cathode to grid of T_9, and current through this tube is at a minimum as is minus bias on tube T_{10}. This tube then supplies a maximum current to the saturable reactor coils for full excitation of the magnetic drive and rated output speed.

Assume the magnetic drive is operating at full output speed, then the tachometer generator *TG* develops full voltage. If arm *AP* is moved back to + terminal of the potentiometer, nearly full voltage of *TG* is applied from cathode to grid of T_9, which passes maximum current. Voltage now increases across R_{11} to where T_{10} grid blocks this tube, which causes the phase-shift network to block the power rectifier to interrupt excitation to the magnetic drive, for zero speed. It is obvious then that locating arm *AP* between the potentiometers — and + terminals gives an intermediate speed, depending on the arm's position. The nearer *AP* is placed toward the — terminal the higher will be the magnetic drive's output speed.

Control Operations. At the bottom of Fig. 3 is the ac driving motor connected to ring of magnetic drive. The drive's magnet with its sliprings connects to a tachometer generator and the driven load. Tachometer generator is shown as a dc machine on the driven shaft. This is for simplicity only. It is a permanent-magnet ac machine belted to the driven shaft. Output of this generator, which produces 12 v at 100% speed, is changed to dc by a selenium rectifier. This voltage is balanced through main potentiometer *MP* against a portion of the fixed reference voltage supplied by tube T_7, Fig. 4, as we have already seen.

Now let us follow through the equipment's operation, which can be on main or auxiliary control by throwing the transfer switch. If on main control, the switch is close to "Main" as shown. This control includes tachometer generator *TG* and main potentiometer *MP*. Auxiliary control equipment is shown in lower left corner and is a manual type used as a standby.

When the main switch, not shown, is closed, power is available at the motor starter, and cathode-heating transformer *CH* is energized. Secondary S_1 heats the cathodes of the 6-phase power-rectifier tubes T_1 to T_6. Secondary S_2 energizes constant-voltage transformer *CV* and the control relays.

Motor can now be started. It comes up to speed without load because the magnetic drive cannot be energized until certain control functions are completed to give the tube cathodes time to heat.

Time-Delay Relay. Transformer secondary S_2 energizes time-delay relay *TD* which starts timing out. In less than one minute it closes contact TD_1. Closing this contact energizes time-delay under-voltage-release relay coil *UV*, which opens contact UV_1 and closes contacts UV_2 and UV_3. Opening UV_1 drops out timing relay *TD*, and its contact TD_1 opens. But *UV* coil circuit is held closed through UV_2 and UV_3. Motor-control interlock contact MC closed when the motor starting contactor closed so anode-contactor coil is energized. It closes its contact to connect the primary of the power transformer to the line and makes secondaries ST_1 to ST_3 alive.

Secondaries in the grid network are also energized. Until the tachometer generator starts, a voltage from main

(*Continued on page 158*)

"HOTTER, SOONER" SAVES YOU MONEY

Yarway Impulse Steam Trap with new stainless steel body.

Yarway Impulse Steam Traps get equipment hot and into production *faster*. Extra profits!

Then they keep it *continuously* at peak operating temperatures for maximum production. More extra profits!

What's the reason for *hotter, sooner?* Just this. When steam is turned on, Yarways open wide, discharging the air and condensate *in a hurry* —closing only when steam arrives. Then, when operating temperature has been quickly reached, the little valve (only moving part) literally *floats on the load* . . . discharging heat-retarding condensate as soon as it forms instead of waiting for quantities to accumulate. Thus equipment is held at peak operating efficiency.

Other economical features of Yarway traps—minimum maintenance, easy installation, low initial cost.

More than 600,000 Yarways have already been installed. Sold by distributors throughout the world.

Try a Yarway today . . . standardize on Yarways tomorrow.

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See Yarway products at the National Power Show, Grand Central Palace, New York, November 27 to December 2. Booths 65 & 66.

Stainless Steel Body

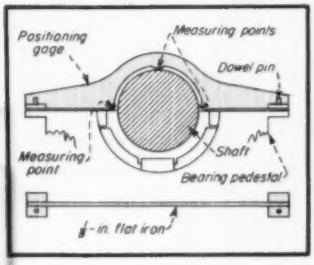
Nest of Yarway traps installed with Yarway Strainers on cloth dryer. Note small space required.

YARWAY IMPULSE STEAM TRAP

POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE

SIMPLE POSITIONING GAGE HELPS ALIGN NEW BEARINGS

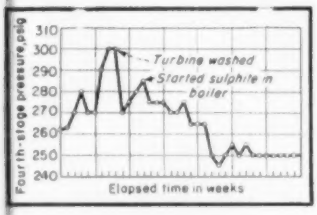


WE HAD TO RENEW the bearings on our 10,000-kw steam turbine-generator unit during a recent overhaul. To speed up the job we decided to preserve the original alignment by replacing the bearings one at a time. Each bearing would then be shimmed to keep the shaft in the original alignment.

To follow this scheme our plant welder made up the tool shown in the sketch at left, one for each bearing. The cover and top half of each bearing were removed. Tools were made up and positioned, as indicated, with light dowel pins. Measuring points at sides and top were rounded off and the clearance made very small so it could be measured with feeler gages. Upper face of the bearing split was closely inspected and cleaned to assure a flat surface where the tool seated. The old bearings were then removed and the new ones fitted to maintain the original measurements.

J A SWANSON *Princeton, B. C.*

SODIUM SULFITE ELIMINATES DEPOSITS ON OUR TURBINE BLADES



WE HAD A LOT OF TROUBLE with deposits building up on our turbine blades. Our main steam pressure is 650 psig, and temperature, 835 F. Bleeder-stage steam pressures would increase, and we had to wash turbines about twice a year. We heard about sodium sulfite curing this trouble so we tried it.

As soon as we started this treatment, stage pressure began to drop as shown in the graph. In a matter of weeks the stage pressure reached guarantee and has stayed there, about a year now.

We use commercial sodium sulfite and carry an excess of 50 ppm in the boiler water. We buy testing solutions from a water-treatment company and use them in our burettes. Chemicals needed are potassium iodide plus iodate 1 ml = 0.5 mg SO_3, concentrated hydrochloric acid and soluble starch.

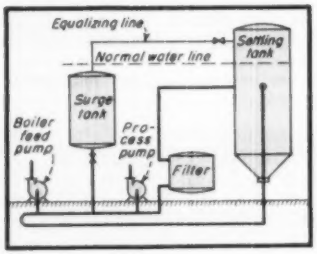
Place 0.5 ml (about 10 drops) concentrated hydrochloric acid in a casserole and add 100 ml of water to be tested. Add 1 ml (about 20 drops) of starch indicator to the sample. Titrate with the standard potassium iodide-iodate solution until the sample develops a permanent blue color. Ppm of sulfite as SO_3 equals ml potassium iodide-iodate, times 500 divided by the ml of sample. Using a 100-ml sample, the ppm of sulfite equals the ml of potassium iodide-iodate solution used, multiplied by 5.

The starch solution is the same as that for a Winkler oxygen test.

K M WHITE *Clinton, Iowa*

EDITOR'S NOTE: Current practice carries an excess of 15-ppm sodium sulfite compared with the 50 ppm used by Mr White. Others have reported that high excess has caused offensive odors in the turbine room. Corrosion of boiler surfaces and turbine casing near the condenser have been eliminated by reducing sulfite excess in boiler water.

SURGE TANK TAKES CARE OF PEAK TREATED-WATER DEMANDS



SOME OF OUR PLANTS have hot-process lime-soda water-softening equipment for boiler feed and process water. The latter demand fluctuates widely and has caused the pumps to flash because of the pressure drop through the filter. The filter also fouls up rapidly during the high peak flows. We considered installing additional softening capacity, but the average water consumption was way below rated capacity of present equipment.

To eliminate the trouble we finally installed a surge tank as shown in the sketch. Bottom of the tank is about 9 ft above the pump center lines. During high flows the water drops in the surge tank. As soon as the demand lets up the surge tank fills up gradually. Size of the tank will depend on the duration of the excess demand. Three installations in different plants have all performed in very good fashion.

L G GRIEBLING *Akron, Ohio*

For more plant-tested ideas, turn page ➤

SUNTAC ENDS LUBRICATION HEADACHE

Keeps Plant in Full Operation and Reduces Oil Consumption 50%

Cold-rolling threads on cold-headed bolts is a tough operation, and a mighty big financial headache, if the thread-roller does not receive proper lubrication.

Such a condition developed in the plant of a well-known manufacturer of screw machine products. Oil ran out of bearings and would not adhere to the guides for the reciprocating die holder. On several occasions the main bearings overheated and seized up. In each instance four days' downtime resulted, costing a large amount for labor and 30 percent in bolt production. Furthermore, the oil loss became so excessive that maintenance crews actually had to put in extra work to keep floors clean and safe.

In his search for a solution to the problem, this manufacturer called in a Sun representative, who induced him to try Suntac Oil. In the 18 months which have elapsed, there have been no production losses attributable to inadequate lubrication, downtime has been eliminated, and cleanups have been reduced to a routine minimum. The consumption of oil has been cut in half. Savings on oil and maintenance have amounted to more than $3,000.

Suntac Oils are recommended for general lubrication in all machinery where retention of oil in bearings is a problem. These "Job Proved" products cling to the parts to be lubricated. For further information, call or write your nearest Sun Office.

SUN OIL COMPANY • *Philadelphia 3, Pa.*
In Canada: Sun Oil Company, Ltd.
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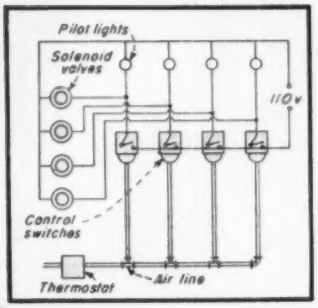
SUN PETROLEUM PRODUCTS
"JOB PROVED" IN EVERY INDUSTRY

SUNOCO®

 Continued from page 128

PILOT LIGHTS AID OPERATOR IN RUNNING COMPRESSOR



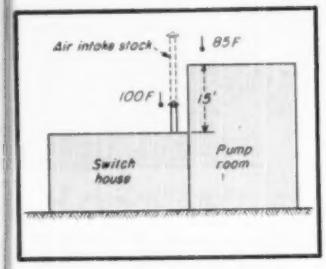
WE HAD A PROCESS air-conditioning hookup with four evaporators, each having a solenoid-controlled expansion valve. Two compressors supplied the evaporators. They were valved so either one or both could carry the load. The evaporators were required to hold temperatures within 2 F of the set cooling level.

Pneumatic thermostat in the cooled space controlled temperature by bleeding air off a branch line. This varied the air pressure with temperature and operated the electro-pneumatic switches controlling the solenoid-operated expansion valves. These switches are set to open or close in sequence.

The coils were concealed in ductwork, and the operator had trouble deciding when the load called for putting the second compressor in service. We solved this situation by installing pilot lights in parallel with each valve solenoid as shown in the sketch. When all four lights are on for 10 min or more the second compressor is now put in service. As long as one or more lights are going on and off one compressor can handle the load.

ALLAN ROCKLIN *Chicago, Ill.*

SMART VENTILATION TAKES ADVANTAGE OF NATURAL CONDITIONS



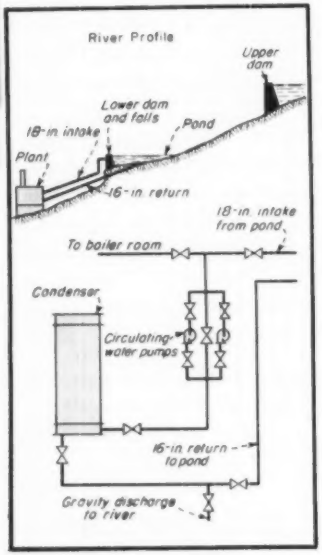
A FORCED-AIR SYSTEM of ventilation cools our switch house. It pulls in outside air through an intake stack above the roof. On hot, sunny days cooling proved to be inadequate; we needed a definite improvement in performance. So we made a critical survey of our ventilating installation.

Sketch shows that intake point was in a "protected" position below the higher pump-room roof. We took temperature readings on the two roofs using a shaded thermometer. Above the pump-room roof, air temperatures were recorded at 85 F, but at the air-intake point the temperature was 100 F. To take advantage of the cooler source of air we simply raised the intake stack 5 ft above this roof.

In addition we covered the stack with aluminum paint to reflect sun radiation. Results were gratifying. For the same outside conditions the ventilating air in the switch house entered at 90 F, an improvement of 10 F.

J D CONSTANCE *Cliffside Park, N. J.*

DAM PERFORMS MULTIPLE DUTY FOR COOLING-WATER SERVICE



OUR CITY ACQUIRED a plant for electrical and heating service, which had diesel, hydro and steam equipment. Growing load required adding 2000-kw steam-turbine capacity. The turbine supplies extraction steam for district heating. Condensing-water supply presented the major problem.

The river feeding the hydro unit varies in flow from thousands of cfs during high water to a mere trickle in summer. This meant water had to be stored for cooling purposes during low flow periods. Dam for the 500-kw waterwheel is about 1500 ft upstream from the plant and produces a 67-ft head at the plant. The pond behind the dam seemed a likely source for cooling water on first consideration. But studies showed the cost of 1500 ft of discharge piping back to the dam and the cost of rock excavation were impracticable.

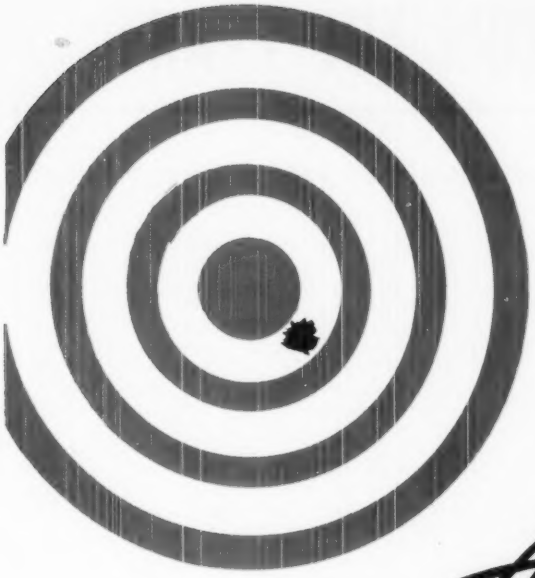
The problem was solved by building a dam 12 ft high across the brink of a falls 400 ft upstream from the plant. This dam provides gravity flow through the condenser during normal river flows, the water discharging into the river below the plant, see sketch. During low water the circulating water is pumped back to the pond through a 16-in. pipe. An 18-in. pipe brings water from the pond to the plant. The pond surface is large enough for present cooling duty. For future expansion or higher vacuum, sprayheads can be added later.

This arrangement gives us a very flexible system, eliminating pumping needs during most of the year, and assuring an adequate cooling supply during low-water seasons.

F B MAES *Redwood Falls, Minn.*

YOUR IDEAS HELP OTHERS

Power men have repeatedly expressed appreciation for ideas picked up from these pages. Do you have something to contribute? Your manuscript need give only bare facts with sketches in pencil. We'll dress it up and pay you $20 for each item accepted.



Almost

ISN'T GOOD ENOUGH!

Especially when you're buying a water conditioning service!

Sound engineering ability is easier to claim than it is to prove. In fact, the phrase has been used so indiscriminately that it has lost much of its true significance. But here at BETZ, we have never lost sight of its real meaning.

Sound engineering ability has always meant *"completely outstanding performance"* in the water conditioning service bearing our name. There is over two decades of continuity in our efforts to offer a nationwide water conditioning service that is scientifically correct—designed to help you cut plant operating costs. May we show you how and why?
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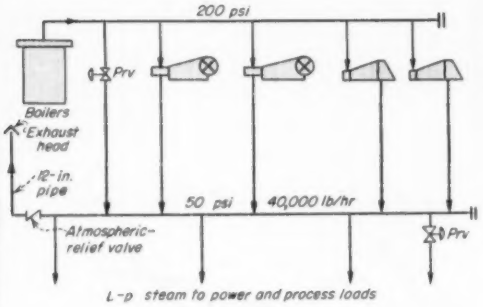
PROBLEMS FROM THE PLANT

THIS MONTH'S QUESTION: What Kind of Alarm For Process-Steam Wastage?



WE HAVE SEVERAL ENGINES and two noncondensing turbines that exhaust to power and process loads. See sketch. At times we waste large quantities of steam to atmosphere. If we had sufficient warning we could shift power and process loads and avoid all or most of our wastage.

Lately we've been thinking of installing an alarm on the atmospheric-relief valve. This would ring or light up when valve opened. Now one of the gang is suggesting use of a recording flowmeter with an orifice in the relief line. I think we could use an orifice plate and a manometer.

Here's the problem. Have any POWER readers ever used one of these setups? If so, how was it built, where was it hooked into the line, and how was it calibrated, if at all? We need sketches and reasons for using a particular method. Also, about how much would it cost?—*GH*

Exercise your engineering wits by submitting answers to above question, fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

The August Question

(This question from the August issue is followed by best answers from readers.)

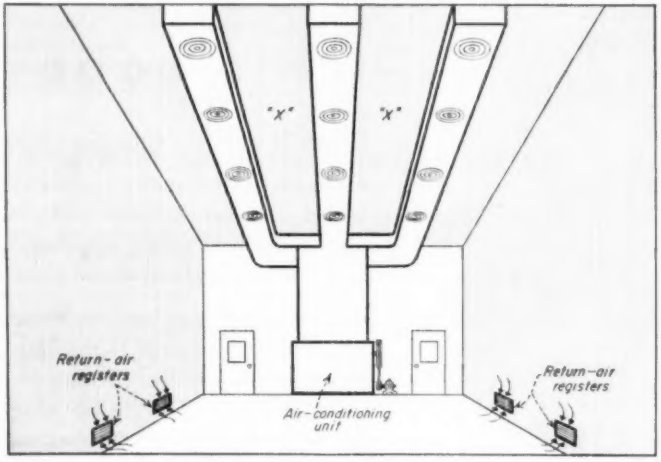
CAN AIR-CONDITIONED PLANT AVOID DRAFTS?

We're planning a new plant for manufacture of small metal parts. Each floor will be air conditioned as in sketch [POWER, *Aug, p 134.*] *Room temperature needed is 58 to 62 F with a relative humidity of 50%. One hundred girls will be employed on each floor.*

We're up against two problems. First, each floor must have good air circulation. "Dead spots" will affect product quality, increase rejects. Second, drafts must be avoided. The girls will all be sitting and if there is the slightest draft some will complain.

I've been wondering about using a perforated ceiling or more ducts and outlets. To avoid dead spots I think a return duct should be installed. We have to get good circulation but cannot have any drafts. We're aiming for smooth distribution at low initial cost.

I'd appreciate help from POWER *readers who know how to lay out an air-conditioning system. Sketches showing supply and return duct layouts or use of a perforated ceiling will be most helpful.—BL*



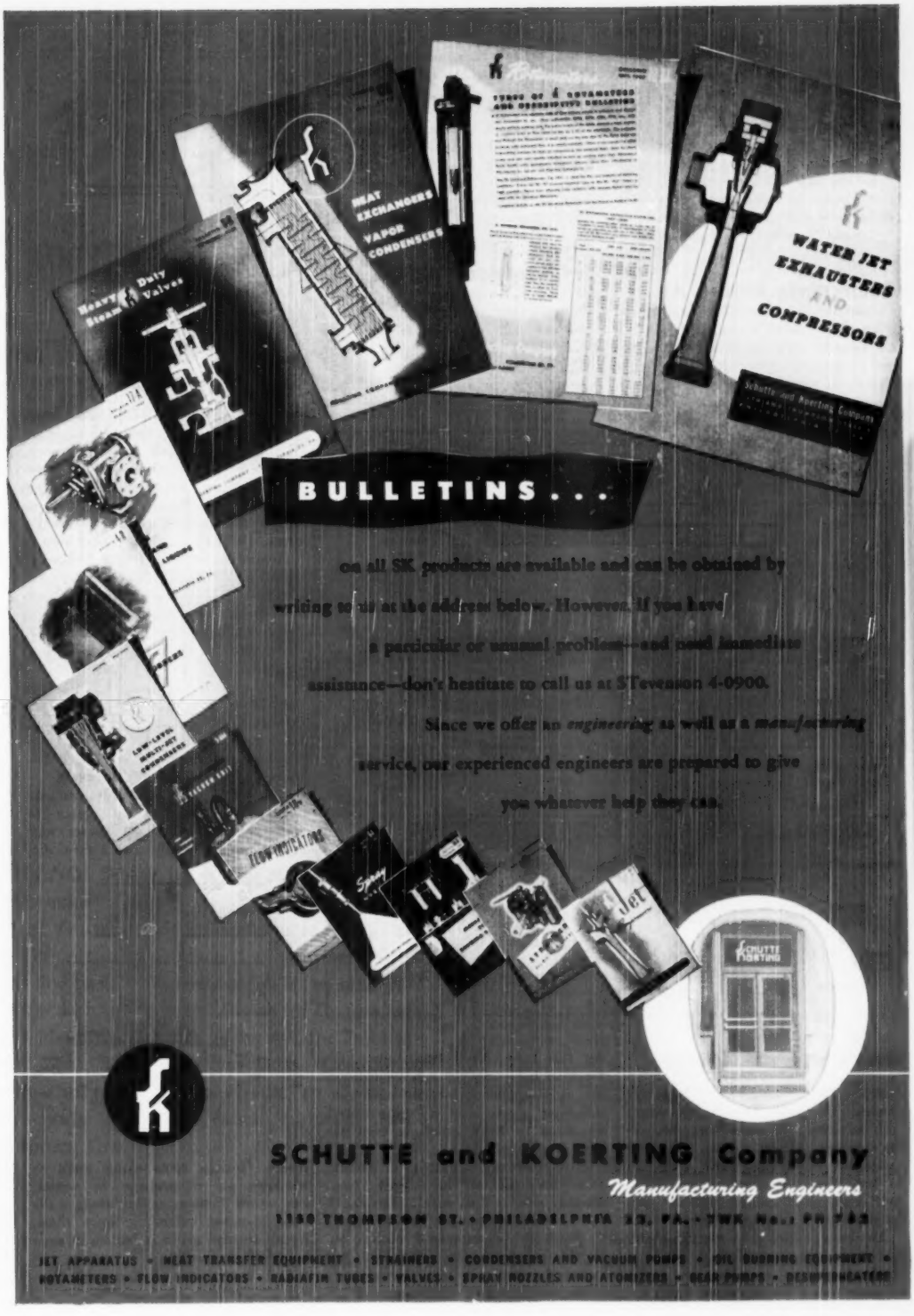
Simple Ducts Best

IT IS UNUSUAL to use a temperature of 58 to 62 F in a room where women sit at their work. This is entirely out of the comfort zone and worker efficiency won't be high. Even in precision manufacturing, temperatures are kept at 75 to 80 F with 45 to 50% relative humidity.

Low temperatures *BL* wants to maintain call for careful air distribution. I assume he has figured the 4420 cfm shown in sketch and his big problem is even distribution of this air.

Design of distributing ducts, location of openings and outlet type depend on room size and ceiling height. I judge room to be about 60 x 70 ft with a ceiling height of 10 ft.

As shown in sketch, I suggest *BL* use 12 face-down distributors spaced in accordance with manufacturer's recommendations. I've used these distributors and found them excellent for low-temperature work. My sketch is not to scale and ducts are exaggerated somewhat. I believe simple ducts will be cheaper than a perforated ceiling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WATER JET EXHAUSTERS AND COMPRESSORS
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because air distribution and insulation with latter are quite complicated.

Space the return registers evenly around room about 30-in. above floor with connecting ducts on ceiling below, or run ducts in the room. Provide exhaust ducts at points marked *x* in the sketch. These remove odors from room. BL's outside-air connection looks good and can be like his sketch.

GEORGE GRIFFEL *Bronx, N. Y.*

Recirculate Return Air

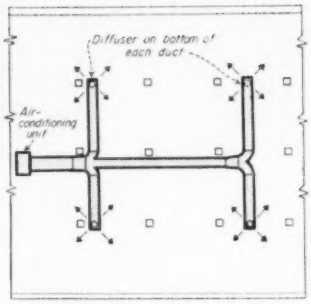
BL DOESN'T GIVE enough information to solve the problem completely. But if air velocity at grille discharge is low and temperature difference between discharge air and room air is small, there won't be noticeable drafts. If ceiling diffusers are used he can handle more air with fewer drafts and dead spots than he can with velocity-type grilles.

I recommend that he use return air for recirculation instead of all fresh air. Of course, he should stay within State codes for minimum amount of fresh air allowable.

F D RAPHAELIAN *Millburn, N.J.*

Try Standard Diffusers

WITH 62 F MAXIMUM temperature and all occupants doing sedentary work draftless air delivery is essential. Perforated-ceiling distribution system would give draftless delivery but cost would be rather high. A dropped ceiling is needed besides ducts, outlets.

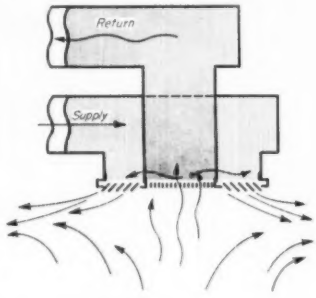


Many types of diffuser outlets are available for mounting on bottom of ductwork. These do an excellent job of air delivery. Air is discharged nearly parallel to the ceiling in a 360-deg arc around diffuser. Conditioned air aspirates room air from below diffuser. Room and conditioned air mix at diffuser periphery from where the mixture diffuses through room. Delivery is almost draftless.

Aspiration with most such devices is sufficient to give an air-stream temperature 2 ft from diffuser, less than half the difference between supply and room-air temperature. Cold draft effect sometimes felt with sidewall outlets is greatly reduced.

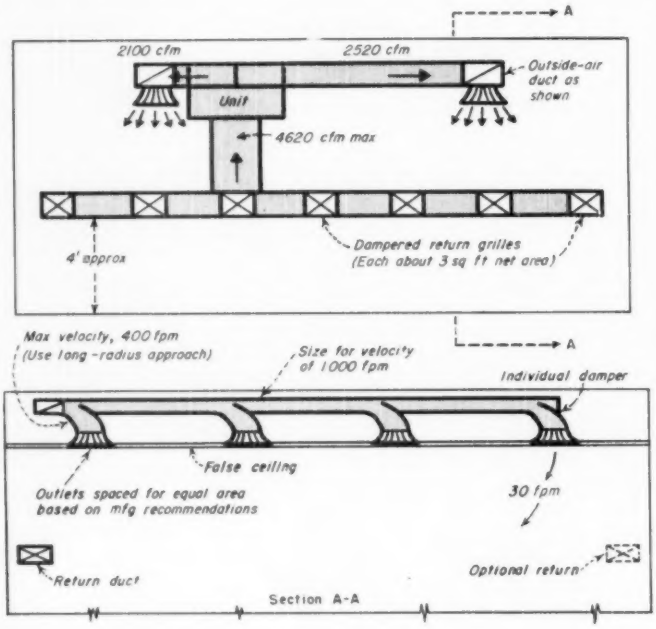
Assuming *BL's* column spacing is not over 20 ft, four diffusers located as in sketch above suffice. If ceilings are low, more outlets will be needed. Blankoff sections of diffusers discharging against nearby columns.

Use returns where accurate temperature control throughout space is necessary. Sketch below shows way of combining supply and return diffusers. If cold spots along walls or windows are a problem in winter, run return ducts at ceiling along walls with branches extending down them. Install vertical grille at bottom of each branch just above floor.



W T WEINHARDT *E. Liverpool, O.*

(*Continued on page* 178)



Here's a Good Layout

SUPPLY DUCT APPEARS properly located. To obtain even temperatures with minimum air movement use ceiling outlets. There won't be any noticeable drafts and first cost will be low. Use rosette type. They blend well with most ceiling finishes and do not detract from room appearance.

Air throw, outlet velocity, noise level and static pressure required must be obtained from manufacturer. Air movement of about 20 fpm is suitable for this room. Keep temperature differential between room and conditioned air at minimum consistent with conditioning needs. Use a well-rounded approach to each outlet so even air flow is secured.

Locate return-air duct as in sketch. This arrangement has least cost. Another similar duct with grilles could be installed in opposite end of room, if desired. Use dampered outlets on supply and return so system can be balanced when put into operation.

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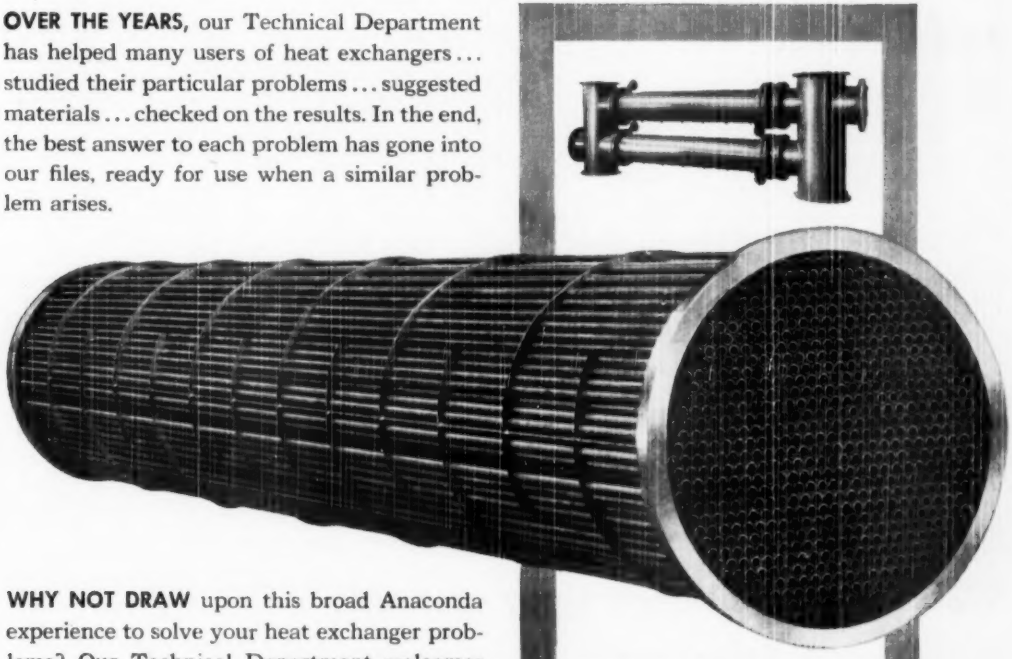

UPPER PHOTO shows Adams two-shell, single stage aftercooler designed to control temperature of compressed air and to condense water and oil vapors present. The condensate is removed by a separator. Built by R. P. Adams Company, Inc., Buffalo, N. Y.

LOWER PHOTO shows tube bundle for aftercooler. ANACONDA Arsenical Admiralty Tubes, Muntz Metal Tube Sheets and Brass Baffles.

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REVIEWED IN THIS ISSUE

SEALS AND GASKETS: Oil-Industry Gaskets • Hydraulic Seals: Rotary and Oscillating; Reciprocating

STEAM GENERATION: The Fluid-Energy Pulverizer and Its Application to Steam Generation • The Steam and Power-Plant Economy and Capability at the Louisiana Station • Standardized Boiler Units

BUILDING MATERIALS: The Exterior Walls for Construction of Industrial Buildings

METERS AND INSTRUMENTS: Radioactive Snow Gage and Telemetering System

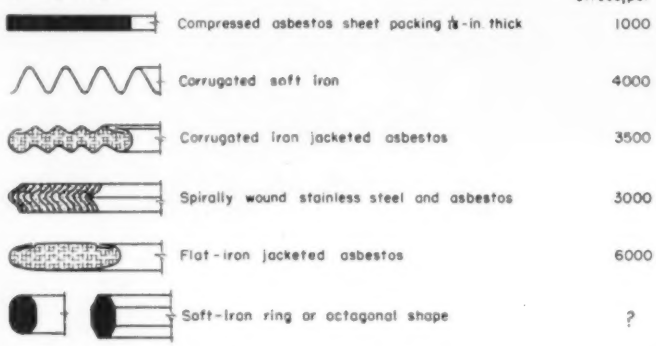
WATER TREATMENT: The Inhibition of Foaming

Directions for ordering papers are given on page 138

Seals and Gaskets

OIL-INDUSTRY GASKETS, *by H H Dunkle, Johns-Manville Sales Corp.* The oil industry has been the most important factor in the development and growth of the metallic-gasket industry. This was one of the first to require the use of many joints that could be easily disassembled in lines and vessels handling a wide range of pressures and temperatures. In the last few years, the pressure limits have been extended to include a range from full vacuum to 30,000 psi, and temperatures from 320 F below zero to nearly 2000 F.

Because of the range of temperatures and pressures that must be held and the wide variation in the equipment to be sealed, relatively few of the available materials and styles of gaskets are in general use in the oil industry. This paper is confined to the six basic styles, Fig. 1, used in the oil industry. These include compressed asbestos-sheet packing; corrugated soft iron; corrugated-iron jacketed asbestos; spirally wound stainless-steel asbestos; flat-iron-jacketed asbestos; and soft-iron ring joints, oval or octagonal shaped. Merits and limitations of each of these gaskets are outlined and various features are given of installation techniques or closure designs that have an effect on their performance.

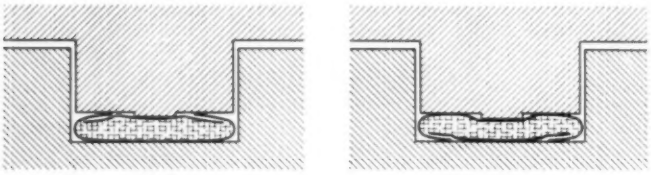


1 Basic materials used for gasket service in oil industry, their arrangement, seating pressures are shown. Compressed-asbestos-sheet has the most universal use

Compressed-asbestos-sheet packing is the material used almost universally in the oil industry from the time oil comes from the well until the finished product is shipped. This material is essentially asbestos fiber bonded with a small percentage of rubber compound. Because the material is relatively soft, the standard 1/16-in.-thick gasket can be sealed without excessive overstressing of bolts or flanges, even though the flange facings may be in poor condition.

Sheet-packing gaskets can be used throughout a wide range of temperatures and pressures, and the general-purpose sheet gasket will resist reasonably well attacks of both oil and oil products, even though not specially compounded for these materials.

Limitations of sheet-packing gaskets depend on the relation of operating temperature to pressure. Sheet packing can be used to seal almost unlimited pressures at room temperature if the closure is designed to give sufficient reinforcement and the gasket is thin. But asbestos fiber loses its strength and turns to powder at temperatures not much over 700 F at a rate that depends on the temperature. At 1300 F, the change is almost instantaneous. When combined with rubber as a binder, loss of strength is not appreciable at temperatures below about 900 F, and sheet-packing gaskets may be used without trouble for low pressures at temperatures up to 850 F. Over this temperature, sheet packing has little strength or ability to seal in flanges subject to bending or vibration, and pressures much above 50 psi. Where compressed-asbestos-sheet packing gaskets cannot meet the requirement, some form of metal gasket must be used. *ASME paper No. 50—Pet.—6.*



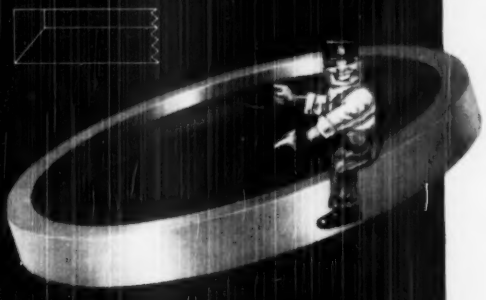
2 Metal-jacketed gasket can be used where sheet asbestos won't hold but there is a right and a wrong way to install those with a raised nubbin on one face

For more briefs, turn page→

Need special high pressure gaskets such as these?

Flare-type Gasket with Bellows Action

Delta Joint Gasket



Pressure Seal Joint Gasket

We tailor them to your specifications

If you require high pressure gaskets made to extremely close tolerances—for service exceeding 10,000 psi. for example—and fabricated to any desired diameter or cross-section, why not look into the special service that Goetze offers for making these gaskets to your order.

The gaskets shown above are typical of the wide variety for high pressure service that have been made to order for Goetze customers. The flare type gasket with bellows action illustrated at upper right is but one example of what Goetze "know-how" can accomplish.

Goetze has had over sixty years of experience in making specialized metallic gaskets for industry's most complex jobs. Modern machines—many of them specially designed and built by Goetze—enable Goetze craftsmen to produce gaskets of any required design, shape or size . . . and deliver them with remarkable promptness.

For further information about Johns-Manville Goetze gaskets, write for a copy of the new Goetze Gasket Catalog. Or send us a drawing or template for assistance on your specific problem. Address Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville *Goetze* GASKETS

THERE'S A JOHNS-MANVILLE PACKING AND GASKET FOR EVERY SERVICE.

HYDRAULIC SEALS, *by T E Beacham, Engineer, and F H Towler, Engineer—members of Institution of Mechanical Engineers, England.* This paper, published in the *Institution of Mechanical Engineers' Proceedings*, 1949, has been republished by the *Journal of the American Society of Naval Engineers, Navy Dept., Washington, D. C.* August 1950, p 631-645, Vol 62, No. 3.

Divided into two parts on rotary and oscillating seals and reciprocating seals, the paper gives a comprehensive treatment of the subject. It deals with soft packings, leather seals, rubber, and synthetic-rubber seals, cork seals, metal-to-metal and metal-to-carbon seals, journal seals, face seals, hydraulic packings and sealing materials, mechanism of automatic seals, effects of motion, friction and wear, packingless pistons, surface finish, grooving of packingless pistons, and hydraulic lock.

In the opinion of the authors, rotary oil seals with the packing now available, do not present much practical difficulty at slow and intermittent speeds, even where high pressures are involved. But at high speeds, wear and heat due to friction become important factors.

Common types of stuffing boxes can be manually adjusted when excessive leakage occurs, but many types of nonadjustable or automatically adjusted seals are now used. Little information is available concerning the latter's life that may be expected before leakage becomes such that replacement is necessary.

There is no generally accepted standard on the amount of gland leakage that can be tolerated. Often considerable leakage may not affect the operation of the plant, but with a moderate rate of loss, oil is apt to form an unsightly pool and a limit has to be imposed by cleanliness considerations. In other cases, however, where a limited amount of liquid is involved—for example, in hydraulic couplings—it is important to have minimum leakage.

The standard of 10 cc per hr leakage required for British aircraft pumps is reasonable for small high-speed pumps where the practical limitation is one of cleanliness. On the other hand, U. S. Navy specifications for some purposes give a gland leakage of one drop in 15 min, which is equivalent to about 1 cc per hr.

Automatic packings of the U-leather, flat-leather and cup-leather types, made of oak-tanned and chrome-tanned leather, have proved highly satisfactory for water hydraulic presses. They have been in existence with little change of form ever since the hydraulic press was invented in 1795. Chrome-tanned leathers are sometimes used with oil, but oak-tanned leathers are not suitable for use with mineral oil, which tends to dissolve the natural fats in the leather and make it brittle, particularly if the oil gets warm. *American Society of Naval Engineers, Navy Dept, Washington, D.C.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from one of the following sources or is specially identified at the end of each abstract.

American Society of Mechanical Engineers Petroleum meeting, New Orleans, La., Sept. 24-28, 1950. Fall meeting, Worcester, Mass., Sept. 18-20, 1950. Papers are identified by initials ASME. Obtainable through ASME, 29 W 39th St, New York 18, N. Y.

Steam Generation

THE FLUID-ENERGY PULVERIZER AND ITS APPLICATION TO STEAM GENERATION, *by L D Bechtel, Carroll, Bechtel and Langtry Div, Commercial Testing and Engineering Co, and G M Croft, Blaw-Knox Div, Blaw-Knox Co.* There has been considerable engineering research in development of the fluid-energy type of pulverizer during the past ten to twelve years. Some has been directed along the lines of promoting locomotion and some into industrial steam generation consuming various fuels.

Blaw-Knox Co felt it advisable to develop a method of (1) pulverizing and economically burning inferior grades of fuel (2) effecting greater use of large quantities of coke breeze accumulated from coke manufacture. Further, the pulverizing equipment would have to fit many existing furnaces designed for a higher-quality coal pulverized 70% through 200-mesh screen. With the lower-quality fuels, pulverization would have to be finer than 75% through 200-mesh screen.

Fluid-energy pulverizer will produce fuel to a fineness in excess of 90% through 200-mesh screen. Paper describes the operating principle and with a wash drawing shows working components and their arrangement.

Various functions of classifying and drying are discussed as the Blaw-Knox pulverizer handles them. Test results on an early-design unit are reported, and also the experience compiled by two industrial concerns over the past three or four years. Some very helpful material on the cost of maintenance is included. *ASME paper. No number.*

STEAM AND POWER-PLANT ECONOMY AND CAPABILITY AT LOUISIANA STATION, *by R J Robertson and W B Gurney, Gulf States Utilities Co.* For the past 20 years the Gulf States Utilities Co have been serving the Esso Standard Oil Co. Baton Rouge, La., refinery as a steam-electric customer. And in addition they have served as a disposal agent for many of the refinery's non-merchantable waste fuels. In 1938 the Ethyl Corp was added as another steam-electric customer. Generating capacity at the station has grown from 45,000 to 210,000 kw and from 1,400,000-lb-per-hr steam output to 4,350,000. Present contracts with Esso Standard and Ethyl call for 120,000 kw and 1,880,000 lb per hr of 135 psi, 438 F process steam.

Plant is divided into two parts, one a 600-psi and the second a 900-psi plant. Heat balance and fuel of the 600-psi plant is discussed as well as the major equipment in each.

Burning of acid fuels gets considerable space, mostly because the authors feel it is a costly operation requiring a great deal of skill both in preparation and combustion.

Their findings indicate that the air heater is essential to minimize corrosion. Future progress seems toward higher-temperature air, possibly as high as 1000 F and higher-capacity burners. To omit the air heater represents a major loss of boiler capability and efficiency. Burning waste fuels in open pits constitutes a waste of a natural resource and a serious loss of revenue. *ASME paper No. 50—Pet.—8.*

STANDARDIZED BOILER UNITS, *by Carl E Miller, Combustion-Engineering Superheater, Inc.* In the manufacture of boilers much progress has been made in the last ten years toward standardization. This progress has come largely from a desire to pass on the benefits of lower capital investment, quicker delivery, simplified engineering to boiler customers.

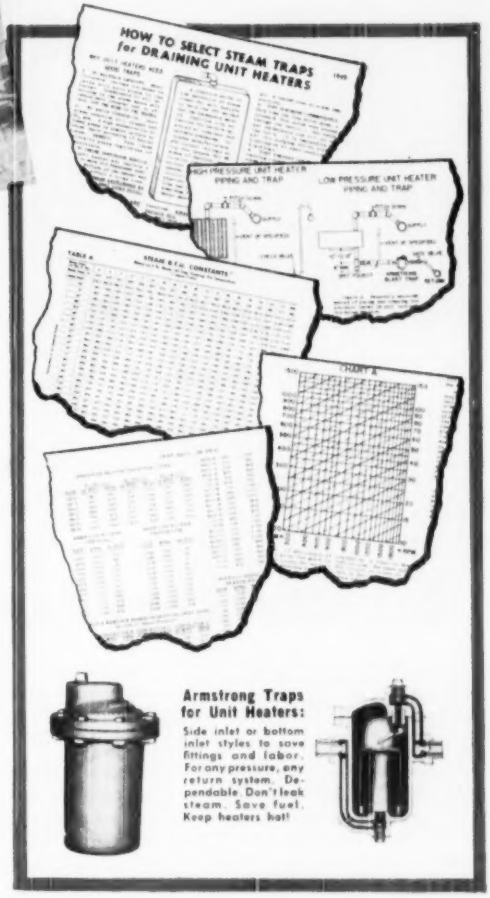
Recent studies by reputable engineers indicate the need for replacing more than 150,000,000 lb of existing steam-generating capacity. These studies were based on a 30-yr life for power-plant equipment. Power-plant obsolescence in certain areas has reached the staggering proportions of 40 to 75%. So the replacement market should be good.

A standard boiler is held to be one completely designed in reasonable-size increments to take care of various space conditions and various fuels and firing methods. Essential information such as size, fuel-burning equipment, fuel-flexibility and performance are all tabulated. Drums, tubes, headers, arrangement of heat-absorbing surfaces, soot blowers

(*Continued on page 204*)

HOW TO SELECT UNIT HEATER TRAPS

1. To obtain full BTU output
2. To insure continuous service
3. To avoid corrosion


HOW TO SELECT STEAM TRAPS for DRAINING UNIT HEATERS
HIGH PRESSURE UNIT HEATER PIPING AND TRAP
LOW PRESSURE UNIT HEATER PIPING AND TRAP
TABLE A
STEAM B.T.U. CONSTANTS
CHART B
Armstrong Traps for Unit Heaters:
Side inlet or bottom inlet styles to save fittings and labor. For any pressure, any return system. Dependable. Don't leak steam. Save fuel. Keep heaters hot!

THE ANSWERS are in a new 8-page handbook prepared by Armstrong! Only thing of its kind, this manual explains why it is important to use dependable traps that are properly sized and that will discharge condensate and corrosive incondensable gases at steam temperature; tells how to select traps by the BTU Method and the Condensate Weight Method; includes tables of BTU outputs of the heaters produced by 24 different manufacturers; discusses heater manufacturers' recommendations on types of traps to use and methods of installation; and includes tables and charts for working trap selection problems.

Anyone is welcome to a copy of this helpful guide to better unit heater performance. Address your request to:

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POWER NEWS

BUSINESS ITEMS • APPOINTMENTS • FOREIGN FIELDS
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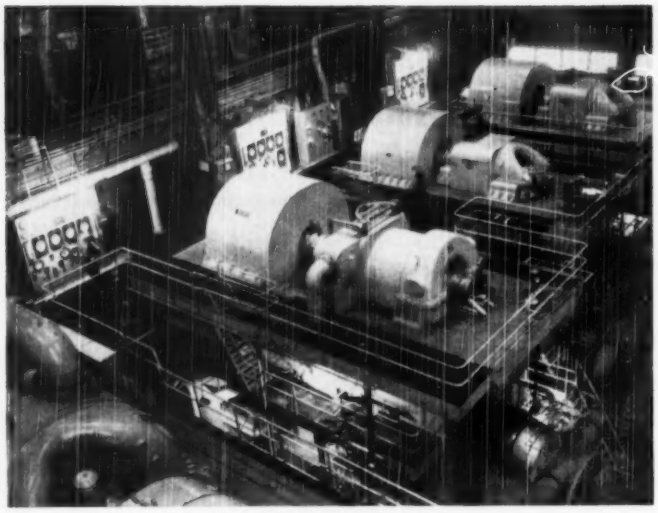


Steam Turbine Drives Steel-Mill Gas Blower

Large blast-furnace turbo-blower in the foreground, recently installed by Dravo Corp's Machinery Division at the Edgar Thompson Works of Carnegie-Illinois Steel Corp, joined two others Dravo placed in operation during the 1943 expansion program at this mill. The new DeLaval machine has a capacity of 121,000 cubic feet of blast air per minute while the other two can each supply 90,000. Turbo-blowers are designed for 650-psi steam pressure and 750 F at the turbine's throttle inlet

COMING EVENTS

Nov 2-3 — Pennsylvania Electric Assn, Prime Movers Committee, fall meeting, Benjamin Franklin Hotel, Philadelphia. E Gordon, chairman, Potomac Edison Co, Hagerstown, Md.

Nov 2-4 — Industrial Management Conference, fourth annual, Univ of Missouri campus, Columbia, Mo.

Nov 27-Dec 2—American Society of Mechanical Engineers, 19th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York, N. Y. Charles F Roth, mgr, International Exposition Co, Grand Central Palace, New York, N. Y.

Dec 4-6—American Society of Refrigeration Engineers, national meeting, Commodore Hotel, New York, N. Y. C W Hudzietz, secretary, Henry Valve Co, 70 East 45th St, New York.

Jan 15-18 — Plant Maintenance Show, Municipal Auditorium, Cleveland, O. Held in conjunction with Plant Maintenance Conference. L C Morrow, chairman, Factory Management & Maintenance, New York 18, N. Y.

Jan 22-26—International Heating and Ventilating Exposition, Commercial Museum, Philadelphia, Pa. 57th annual meeting. Charles F Roth, mgr, International Exposition Co, 480 Lexington Ave, New York, N. Y.

Equipment Keeps Pace With Power Progress

► THE 19TH NATIONAL EXPOSITION of Power and Mechanical Engineering, in the Grand Central Palace, New York, Nov 27-Dec 2, will feature latest equipment designs in the power field.

Displays of greatest interest to visiting power engineers will be those marking the predominant trends in power-plant design—higher pressures, higher temperatures, wider use of controls, the desire for multiple-fuel selection.

Behind these trends stands considerable progress in the equipment serving them. Fuel preparation at the power plant itself has come in for greater attention. As the general grade of fuels has deteriorated, need for closer control through the preparation stage has become more evident. Coal pulverizers make use of materials more resistant to wear so the fineness of coal can be held within closer limits. Oil preheaters deliver oil to the burners at the proper temperature despite changes in viscosity.

Within the furnace itself improved methods and equipment characterize grates and grate maintenance, firebox construction, refractories, stokers.

Controls have experienced a considerable growth in significance in the power plant. Remote indications are now demanded for pressures, temperatures, liquid levels, flow rates and other similar information. Process industries ask for still more instrumentation. They want sensing elements applicable to a wide range of uses. The Power Show will exhibit instruments to meet all these needs including programming controls that monitor entire processes from start to finish. In addition there will be displays of systems that hook up the control of an entire power plant with a series of pushbuttons on the load dispatcher's desk.

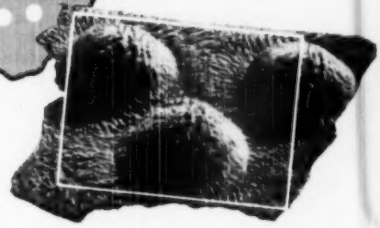
There will be a wide range of auxiliary equipment on the exposition floor. Steam and diesel engines, packaged boilers, variable-speed drives, heat exchangers are just a few of this class promised.

A group of exhibits will be devoted to lubrication, another to feedwater treatment, a third to coal and ash handling, still a fourth to tools and tool-production equipment.

The Exposition, sponsored by the American Society of Mechanical Engi-

(*Continued on page* 212)

Desert Waste...



Rectangle in small photo shows area of scale sample in large illustration. "Hills" are scale-covered rivet heads. Approximate size of sample: 7" x 5". *Nalco Laboratory photo.*

THIS "desert" was formed under water—improperly treated boiler water. It represents needless waste in several ways . . . Boiler down time . . . Overheated drum and rivet metal . . . Loss of heat transfer efficiency . . . Sluggish response to load changes.

Since the scale was removed, The Nalco System has kept the boiler clean-to-metal and corrosion-free continuously—and economically. Where conditions require uninterrupted boiler operation, The Nalco System can also be utilized to remove old scale, as well as prevent new deposits. Either way, The Nalco System is your assurance of *permanent water treatment results.* Write for prompt action on your problems.

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place
Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE *Nalco* **SYSTEM** • **Serving Industry through Practical Applied Science**

JENKINS PRACTICAL PIPING LAYOUTS

55

How to plan

DRY CLEANING SOLVENT DISTILLATION PIPING CONNECTIONS

A solvent reclaimer is standard equipment in practically all dry cleaning plants. By distillation, it removes soluble oils, soaps, and greases picked up by the solvent during the cleaning process, and thus prevents "spots" and unsatisfactory results when the solvent is reused.

The distillation system shown here is applicable to most dry cleaning liquids in common use, such as benzine, naphtha and synthetic solvents. Used solvent is pumped from a storage tank through a strainer to a preheater. In the preheater, which is basically a shell and tube heat exchanger, cold solvent on the inside of the tubes is heated by the solvent vapors on the outside of the tubes. The solvent vapors are thereby partially condensed. The heated solvent then passes through a liquid level controller to the solvent vaporizing chamber.

A steam coil in the vaporizer further heats the solvent and causes it to boil off, since it has a lower boiling point than the impurities. A sludge drain valve is used to remove these impurities periodically from the bottom of vaporizer where they collect. A high vacuum, about 25 inches of mercury, is maintained in the vaporizer in order to lower the temperature at which boiling of the solvent occurs. For this reason, a pressure of about 50 pounds is generally sufficient in the steam coil.

The vacuum in the vaporizer is obtained by the rapid condensation of the solvent vapors in the combination preheater and vapor condenser. Partial condensation takes place when the vapor contacts the coils carrying the cold solvent. Condensation is completed and the resulting liquid sub-cooled by additional tubes in the condenser which carry cold water.

A wet-type vacuum pump removes the distillate from the condenser along with any non-condensable gases, which, if not removed, prevent a high vacuum from being maintained. It then passes to a moisture remover. Generally, the reclaimed solvent is returned to the used solvent storage tank for reprocessing until the operator, by looking through the sight glass, is satisfied with its clarity. It is then passed through filter pads where any last traces of moisture are removed and stored in a tank for reuse.

For control of both hot and cold solvent, Jenkins Fig. 106-A Globe Valves are recommended. When ordered for use in dry cleaning solvent lines, the valves are fitted with Jenkins No. 936-A synthetic composition discs. These are specifically designed to withstand the corrosive action of solvents and will provide vapor-tight closure for a long period before disc renewal is required.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installations.

A CHOICE OF OVER 500 VALVES

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from Jenkins Catalog. *It's your best assurance of lowest cost in the long run.* Despite their extra value, *you pay no more* for Jenkins Valves. Jenkins Bros., 100 Park Ave., New York 17; Jenkins Bros., Ltd., Montreal. Sold through leading Industrial Distributors everywhere.

Reserve your copy of
NEW BOOK OF PIPING LAYOUTS — NOS. 26 to 50

A new book of Jenkins Practical Piping Layouts — Nos. 26 to 50 — is in preparation. Mail coupon to get your copy when ready.

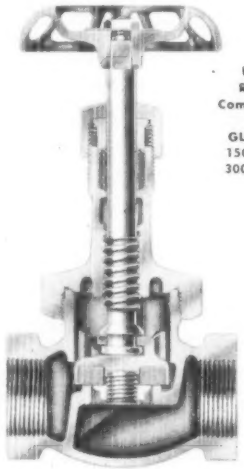


Fig. 106-A
Renewable Composition Disc
BRONZE GLOBE VALVE
150 lbs. Steam
300 lbs. O.W.G.

JENKINS BROS., 100 Park Avenue, New York 17, N. Y.
Reserve book of Piping Layouts — 26 to 50 for:

Name

Company

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DRY CLEANING SOLVENT DISTILLATION PIPING CONNECTIONS

VALVE RECOMMENDATIONS *For details of valves to suit varying conditions see Jenkins Catalog.*

Code	Quan.	Jenkins Valves	Service
A	1	62-U Bronze Gate	Used Solvent Supply Shutoff
B	1	106-A Bronze Globe	Used Solvent to Preheater
C	2	62-U Bronze Gate	Float Controlled Valve Shutoff
D	1	106-A Bronze Globe	Manual By-Pass of Float Valve
E	1	92 Br. Sw. Check	Prevent Solvent Backflow
F	2	106-A Bronze Globe	Tank Connections for Distilled Solvent

Code	Quan	Jenkins Valves	Service
H	1	106-A Bronze Globe	Moisture Drain
J	1	106-A Bronze Globe	Overflow Line Control
K	1	106-A Bronze Globe	Sludge Drain from Vaporizer
L	2	370 Bronze Gate	Pressure Reducing Valve Shutoff
M	1	956 Bronze Globe	Manual Control By-Pass
N	1	956 Bronze Globe	Steam to Vaporizer for Cleaning
P	2	370 Bronze Gate	Condensate Return
R	1	762 Bronze Sw. Chk	Prevent Condensate Backflow
S	1	956 Bronze Globe	Condensate Free Blow
T	1	106-A Bronze Globe	Condensate Trap Test
U	2	106-A Bronze Globe	Level Controller Tank Conn's
V	2	62-U Bronze Gate	Automatic Admission Water Valve Shutoff
W	1	106-A Bronze Globe	Manual Water Admission Valve By-Pass
X	2	741-G Bronze Needle	Solvent Pressure Gage Control
Y	1	741-G Bronze Needle	Pressure Gage Control

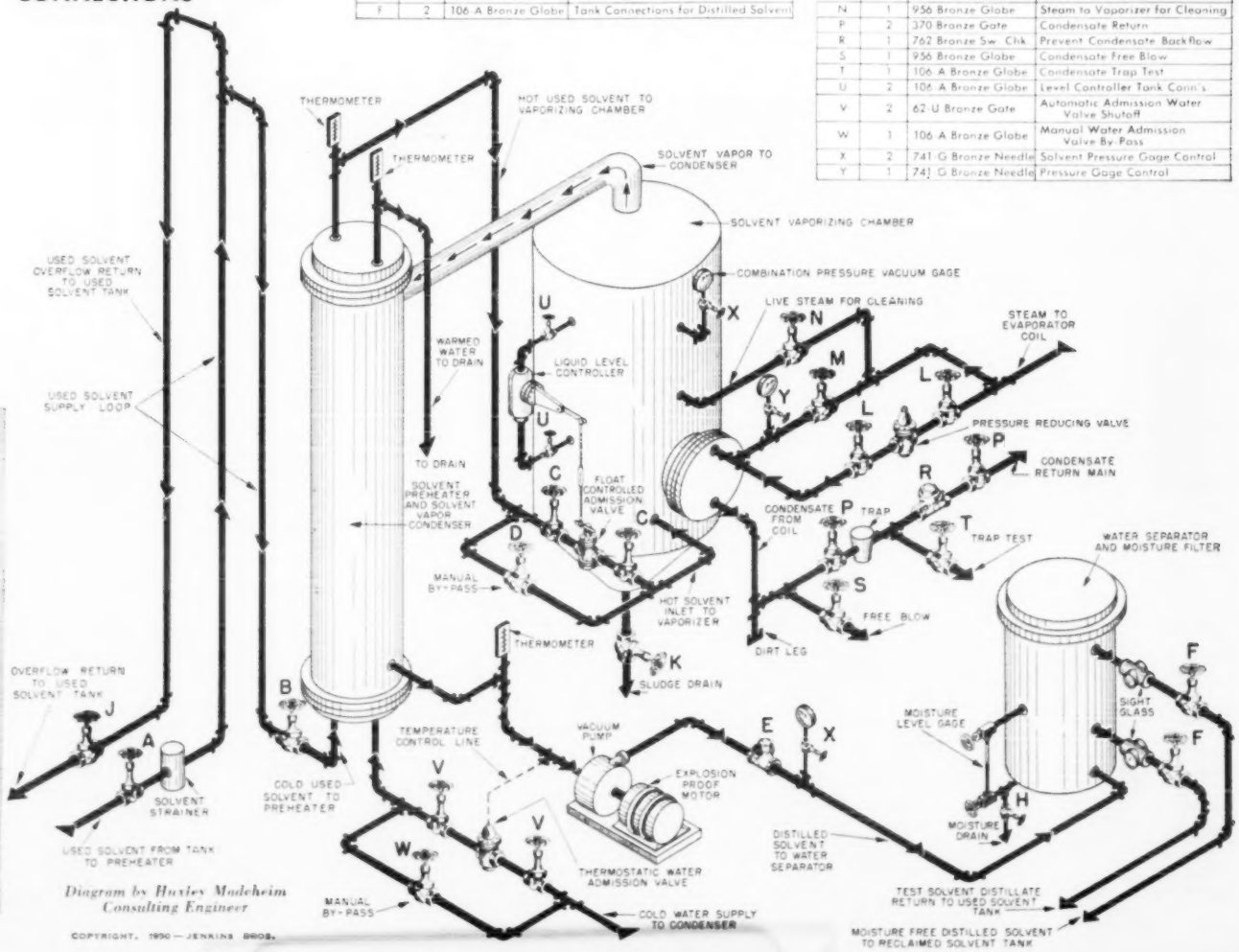

Diagram by Huxley Madeheim Consulting Engineer

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Illustrating the proved 3-point formula for trouble-free, time-defying hookups

A **Use the right type valve for the service**

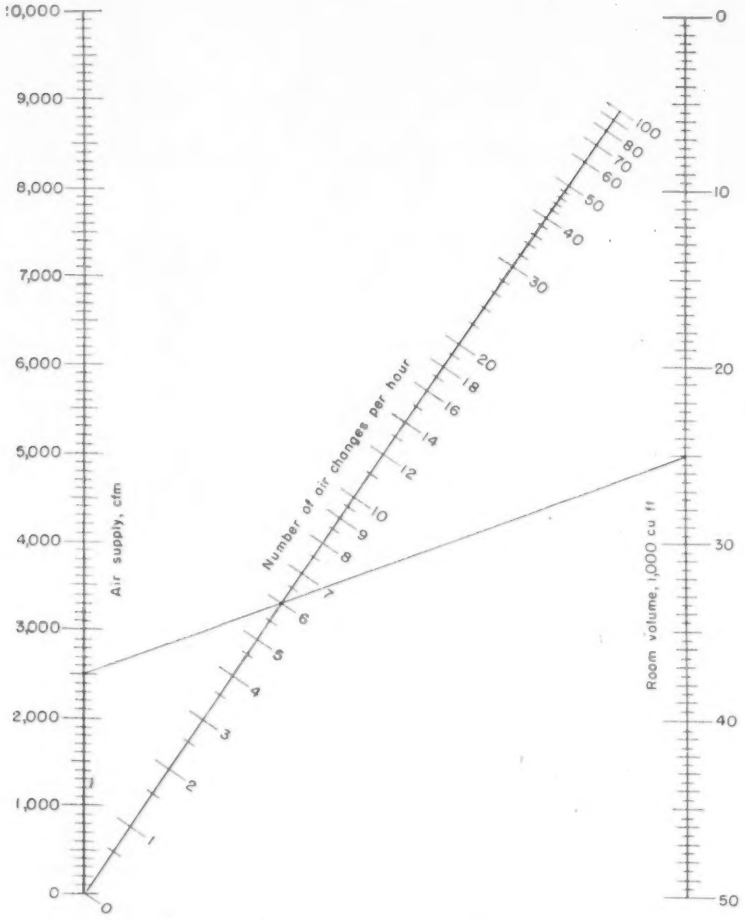
B **Place valves correctly in the line**

C **Choose Jenkins for lifetime economy**

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

Number 221



Estimating Air Changes

► THE NUMBER OF AIR CHANGES per hr can be calculated from the simple formula:

$$\text{Changes} = 60S/V$$

where S = air supply, cfm V = room volume, cu ft

Despite the simplicity of this relation, it takes time to set it up on a slide rule. For any number of repetitive calculations the above nomograph will prove quicker in finding the answers.

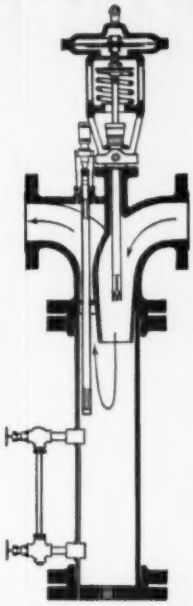
Example: Six air changes per hr are needed in a room of 25,000 cu ft volume. At what rate must the air be supplied from the source?

Find 25,000 cu ft on the right-hand scale. From here lay a straightedge to intersect 6 on the inclined scale and read 2500 cfm on the left-hand scale at the intersection.

TYLER G HICKS, *Assistant Editor*

Self-Contained DESUPERHEATER

Cooling water completely atomized at all rates of flow . . . final steam temperature held closely . . .



Easily installed, the COPES Desuperheater holds the final steam temperature within plus-or-minus 5 degrees F., regardless of changes in initial temperature or rate of flow. Self-contained, it has no outside valve controlling flow. Complete atomization of the cooling water is assured by controlling its flow at the spray nozzle, across which pressure drop is held constant. Intimate contact of water and steam is at point of greatest turbulence in mixing chamber. Write for descriptive Bulletin 405-A.

NORTHERN EQUIPMENT COMPANY
1101 GROVE DRIVE, ERIE, PA.
BRANCH PLANTS: Canada, England, France and Austria
Representatives Everywhere

ENGINEERED BY THE MAKERS OF COPES
FLOWMATIC

COPES furnishes pressure-reducing and desuperheating stations designed and built for the individual installation. COPES also builds-to-measure boiler superheat controls responsive to both steam flow and temperature.

COPES

COPES

Headquarters for . . .

Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

PLANT EQUIPMENT NEWS

Published monthly as a service to readers

Your information center for new products to solve plant problems. Spot what you need, use handy cards p 192a, to get more details

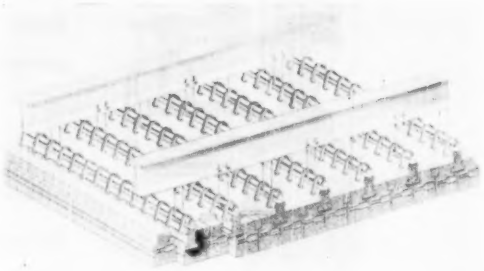
DOUBLE-HUNG REFRACTORY ARCH

P1100 • This pendulum-hung, insulated refractory arch is said to be so highly flexible it can even be attached to a warped steel framework. The accompanying illustration shows how this is possible.

Eye or U-bolts hung from overhead I-beams hold up the individual refractory-supporting tubes. These bolts are long enough to let a mason install a level arch even if the overhead beams are warped or twisted. Because of the grid pattern formed by the main beams and the supporting tubes these main beams need no special spacing between them.

A horseshoe casting that can swing almost 20 deg from the vertical without disengaging lower tiles hangs from the supporting tube. Lower tiles then fit into this horseshoe casting. Freedom of movement of this construction reduces mechanical spalling and avoids sheering of castings.

The positive horizontal "S" refractory locks that attach these lower tiles to the upper ones automatically center any



belt of tiles in the roof. No straightedge, bracing or other mechanical means is needed to hold the lower tiles in position until wedged in by adjacent tiles.

Geo P Reintjes Co, 2517-19 Jefferson St, Kansas City, Mo.

FLOW CONTROLLER P1121

Automatic, low maintenance, highly accurate and fast response flow controller measures flow rate by the company's *Magna-Clutch* flowmeter, and combines with a pneumatic controller that is fully adjustable. Controller has automatic reset and proportional band control from 0 to 175%. Result is a close control of flow.

Penn Industrial Instrument Corp, 3116 N 17th St, Phila 32, Pa.

NIPPLE CHUCK P1125

Threading short nipples with any threading machine or vise can be done with this nipple chuck, which can be fitted without requiring special tools. Adapters are made for ¼, ⅜, ½, ¾, 1, 1¼, and 1½ in. The chuck itself holds 2-in. pipe. Nipples to be threaded are screwed in by hand and after threading are released by an easy turn of the chuck.

Ridge Tool Co, Elyria, Ohio.

VALVE SEAT TOOL P1122

Fast, economical, chatterless operation is claimed for a 4-way, rotary tool, the *Quad*, with an off-center flute design. A standard *Quad* will countersink round or square holes, chamfer and burr, do valve-seat finishing and center reaming on most surfaces.

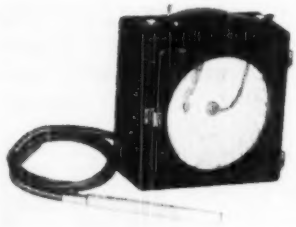
M A Ford Mfg Co, Inc, c/o Sperry-Meister Inc, Union Arcade Bldg, Davenport, Iowa.

MAGNETIC BASE LAMP P1146

Lamp can mount on any iron or steel surface. It utilizes a powerful alnico permanent magnet base. A universal ball-and-socket and swivel arm support the lamp and allow positioning at almost any angle.

Beam of light from the 40-watt bulb is thrown directly on the work. Lamp's adjustable shield has a rayon coating on the outside to prevent operator burning himself on the shield. Model No. 200 *Handi-Lite* comes complete with extra bulb.

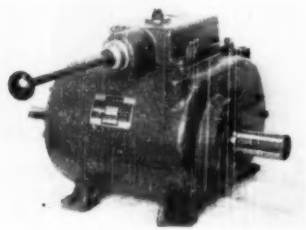
Enco Mfg Co, 4522 W Fullerton Ave, Chicago 39, Ill.



RECORDING THERMOMETER P1114

Self-contained recording thermometer *Minicorder*, needs no outside power supply; can record without attention for up to seven days. Special shockproof mechanism permits mounting it in trucks, trailers, railway refrigerated cars and ships. Temperature ranges in various models cover from −30 to + 165 F. *Minicorder* measures 5¾x5¾x4¼ in., and weighs 3½ lb.

Tagliabue Instr Div, Box 414, Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark 5, N. J.



SPEED CHANGER P1155

Normal speed input of this 20-hp unit is 900 rpm. Four speed changes are in geometric progression of 1.7 to 1 with a 5 to 1 over-all ratio.

All gears and shafts are alloy steel, heat treated. All revolving shafts are mounted on antifriction bearings. Case is oil sealed. Unit, identified as the *420*, is used on machine tools, rubber mills, electrical machinery, etc.

Western Mfg Co, 3400 Scotten Ave, Detroit 10, Mich.

(Continued on page 148)

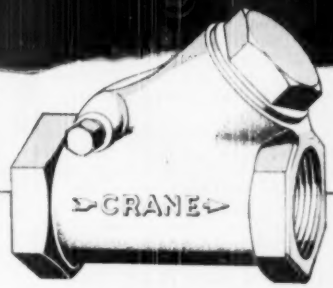
For further data on above items use reply cards on page 192a, identifying your request with letter P and number

More **CRANE VALVES** are used than any other make

Crane "Pulsator" test of check valve endurance. By continuous sudden reversals of air pressure, valve discs are slammed open and shut at rates up to several hundred cycles per minute.

How Many Checks in a Good Check Valve?

You don't buy them that way, but that's what finally determines the value of check valves in your pipe lines. That's why Crane is so completely equipped for accurately pre-testing valve performance. For instance, "wearability" of check valves is tested by opening and closing the valves continuously on various fluids under conditions of actual service. Special equipment is used to accelerate these tests to qual many years' service in a short period. Countless tests like this—of materials, designs, and finished products—insure the superior performance values that mean lower piping costs for users of all Crane valves and fittings.



This new regrinding Brass Swing Check design typifies Crane's continuing product development for better valve performance, lower piping maintenance costs. For increased flow capacity . . . for fast, positive closure on backflow . . . for easier servicing without removing valve from line . . . get a demonstration of these 200 and 300-Pound Y-Pattern Check Valves. Phone your Crane Representative, or ask for literature.

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

EQUIPMENT NEWS *CONTINUED*

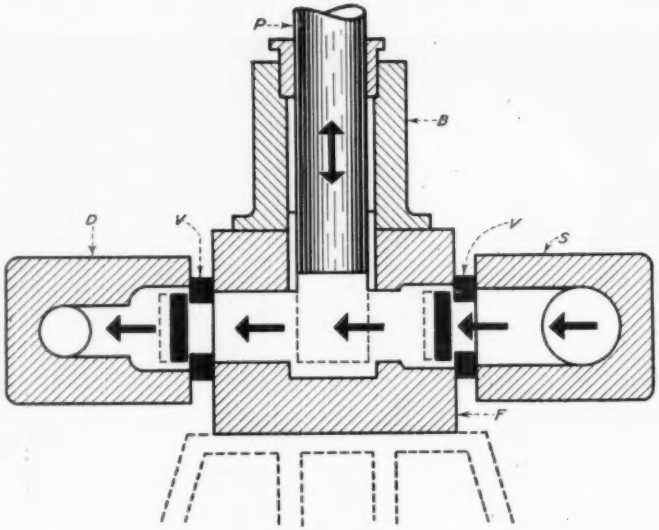
RECIPROCATING PUMP P1159

Direct or through-flow of liquids reduces space volume between valves to increase volumetric efficiency. Fluid end is sectionalized in separate units, which include working barrel, stuffing boxes, valve units, plunger and suction and discharge manifolds.

As drawing shows, suction *S* and discharge *D* manifolds are separate units bolted to the forged-steel working barrel *F*. Valve assemblies *V* and seats held in place by manifolding are easily accessible. Stuffing box *B* can be removed to use different-size plungers *P* in pump. Pumped fluid flows directly from suction to discharge as indicated.

Individual fluid-end sections can be replaced at a fraction of the cost of a fluid end unit. Since almost all wearing parts are interchangeable three sets of them cover a total range of pump sizes from 100 to 2450 hp.

Aldrich Pump Co, Allentown, Pa.



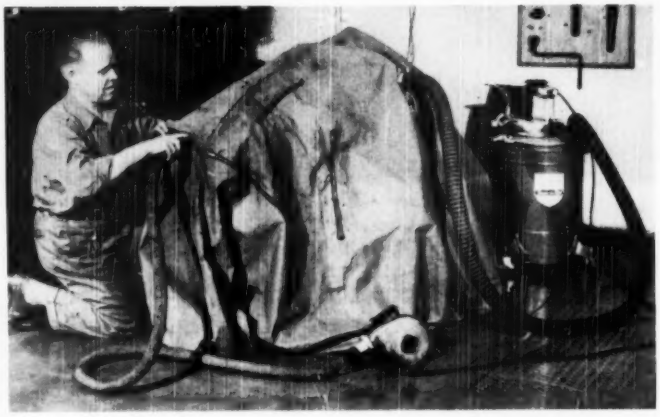
MOTOR-GENERATOR CLEANER P1140

System of cleaning elevator motor-generators uses combination of blowing and vacuum cleaning. Machines are enclosed in a cover of heavy cotton drill, coated on both sides with oil-resistant neoprene. This cover has 15 slits closed by zippers through which blower and vacuum hoses may be inserted to clean the machine. Zippers can be closed tightly around the vacuum hose to exclude most of the air except that coming through the blower opening into the machine.

For a cleaning job the blower hose is put through one opening and the vacuum-cleaner hose with its suction bell intake is zippered in another. Blower and vacuum cleaner are started, and in one operation blower dislodges dirt and vacuum removes it.

During cleaning the vacuum cleaner draws in 270 cu ft of air per min through the open zipper around the blower hose. Dust blown loose by the blower is caught in this air stream and sucked into the vacuum-cleaner tank instead of being blown over other equipment. Blower and vacuum cleaning hose are shifted to different openings in the cover and cleaning operation repeated until machine is thoroughly cleaned. Wiping with rags is not needed to complete job because vacuum cleaner has removed all dust and dirt. Catalog available.

Lehara Sales Corp, 485-5th Ave, New York 17, N. Y.



POWER PIPE MACHINE P1118

Choice of either wheel and roller cutoff or knife is possible now with the No. 999 Super Model 2-power pipe machine. Cutting is rapid with either cutoff, with a rate of 2 in. in 10 seconds. The Super Model has quick opening die heads; can thread 2-in. pipe in 22 seconds. A thread gage shows length of thread being cut.

Toledo Pipe Threading Machine Co, Toledo, Ohio.

CONTROL STATIONS P1149

A 12-unit *Oil-Tite* control station designed for heavy-duty installations. Unit accommodates any combination of 1, 2, 3, 4, 6, 9 and 12 units. Cork-neoprene gasket provides a seal against oil, coolant and water.

Maximum interrupting capacity is 12 amp at 600-v ac. At 110-v ac, pushbuttons will interrupt 60 amp.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

SWITCHBOARD INSTRUMENT P1152

Shadow-free lighting of instrument scales, with conventional plant lighting, features this new line of $4\frac{1}{2}$-in. long-scale switchboard instruments. Designated as types AB-18 (ac) and DB-18 (dc), instruments have protruding convex-type glass cover permitting scale to be mounted flush with front of instrument case.

Shock-resistant bearings in the new in-

For further data on above items use reply cards on page 192a, identifying your request with letter P and number

CORRECT SPECIFICATION

is part of the picture

Revere Admiralty Metal Tubes in a heat exchanger fabricated by the Nooter Corporation, St. Louis, Mo.

● This heat exchanger, fabricated by the Nooter Corporation, St. Louis, Mo., contains Revere Admiralty Metal Tubes. They were specified after a thorough study of operating conditions indicated that they would be the most satisfactory. Though Revere Admiralty Metal Tubes are generally considered to be acceptable under a relatively wide range of conditions, and are bought in such large quantities as to warrant the term "popular," they are by no means all-purpose tubes. In fact, there is no one tube alloy that can be called "best," because condenser and heat exchanger installations vary so greatly in their requirements.

In order to meet these differences, Revere does two things; it makes condenser tubes in a number of different alloys, and it collaborates with its customers, through the Revere Technical Advisory Service, in specifying the alloy most likely to meet individual service requirements.

Among the Revere Condenser Tube Alloys are: Admiralty Metal, Arsenical Copper, Muntz Metal, Aluminum Brass, Aluminum Bronze, Cupro-Nickel. Revere also supplies tube plates in a variety of alloys. If you have any questions regarding the selection of tubes or plates for condensers and heat exchangers, consult Revere.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

struments protect jewels and pivots under all normal and many adverse conditions. This line of instruments is designed for general switchboard service on both large and small equipment. Typical applications are control stations, testing devices, and other installations where space is limited. Units include dc ammeters and voltmeters and ac ammeters, voltmeters, wattmeters, frequency meters, power-factor meters and synchroscopes.
General Electric Co, Schenectady 5, N. Y.

FIRE-ALARM BOX P1144

This electric trip alarm box may be automatically operated by a rate-of-rise or fixed-temperature thermostat, in addition to being manually tripped by breaking the glass. Device is well suited to industrial plants, hotels, hospitals, etc, where several circuits in combination with thermostats are used for automatic fire detection in hazardous areas. *MA-ET* box may be used in each thermostat circuit.

When the box is tripped, either automatically or manually, four complete rounds of coded alarm are sent through audible signals of the fire-alarm system. Device has a prewound spring-driven mechanism. When unit has been tripped, a *NOT SET* target drops into view behind a window set in the box cover. In addition, a neon light (furnished on 110-v boxes) glows until box has been reset.

Resetting is simply a matter of opening door, replacing glass, if necessary, and winding mechanism. When door is opened after an alarm it cannot be closed until box is fully reset.
The Autocall Co, Shelby, Ohio.

GREASE GUNS P1156

Two high-pressure electric power guns of 25- and 40-lb capacity are used where air power is not available. The 25-lb gun, Model 7170-R, delivers 14 oz of light or medium lubricant per minute at 70 F. Unit has 115-v, 60-cycle universal motor that automatically shuts off when pressure reaches 5000 lb.

Model 7175-R is the 40-lb gun that handles all types of grease—fibrous, heavy or light. It delivers 5½ oz of heavy fibrous lubricant per min at 70 F. It also has a 115-v motor with 5000-lb cutout point.
Alemite Div of Stewart-Warner Corp, 1826 Diversey Parkway, Chicago 14, Ill.

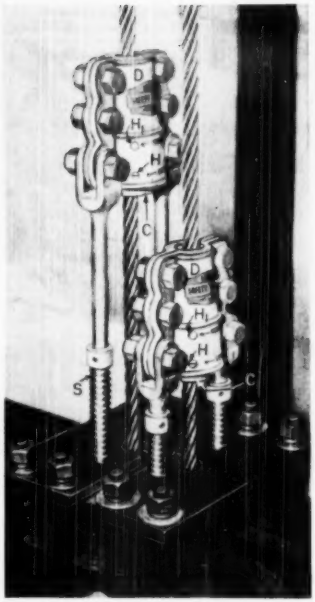
SAFETY CLAMP FOR ELEVATOR ROPES P1139

Elevator ropes fatigue and fail at their sockets, causing a serious hazard to life and property. Designed to protect against such accidents this safety clamp gives ropes a second safety connection to the car. While the clamp is intended primarily for drum-type elevators, it can also be used on traction designs and on counterweights and overhead deadend sockets.

Clamp does not replace the socket on the rope but serves as a protective device in case of socket failure. It consists of a split-tapered drop-forged steel casing *D*, bolted around a divided drop-forged steel wedge or cone *C* clamped to the rope. Casing connects to the car's crosshead by two drop-forged steel bolts. Length of these bolts is adjusted by nuts so springs *S* hold the casing free of the cone.

When cone and casing are in correct relative position a red mark on the cone shows in lower hole *H* in the casing. If the rope fails at the crosshead socket, cone rises smoothly upward in the tapered casing, about 1¼ in. when the mark shows in upper hole H_1. At this point the rope again shares the load and the elevator may be operated until the rope can be resocketed. The heavier the load the more the cone is compressed against the rope.

If a socket only partly fails, the cone leaves its set position and begins to move upward in the case, an indication of pending failure. When a socket fails the rope is not lost as it would be without the safety clamp. It again can be resocketed, whereas without the clamp both ropes generally have to be replaced.
Safety Devices, Inc, Third National Bank Bldg, Springfield 3, Mass.



CHECK VALVE P1137

Circle Seal check valves are made in ⅜ to 1 in. pipe sizes for pressures between 0 and 300 psi and temperatures ranging from -65 to 280 F. Special units are available for temperatures up to 500 F. Valve seats on a circular seal made of Hycar (Buna N) or other synthetic-rubber compounds. Pressure differentials for opening valve are 1 to 3 psi in standard type, and 4 to 8 in. H_2O in low-pressure type. Air, gas, water and many crude and refined petroleum products can be handled by valve. Bodies are brass or aluminum but can be furnished in steel, stainless steel, monel or other materials. Connections are for internal or external pipe, tubing or combinations as specified.
James-Pond-Clark, Pasadena, Calif.

REMOTE METER READING P1112

High-powered prismatic scope together with a universal mounting bracket permits distant reading of water columns, gages. Magnification is enough to read water columns at 100 ft or more.
Kollmorgen Optical Corp, 2 Franklin Ave, Brooklyn 11, N. Y.

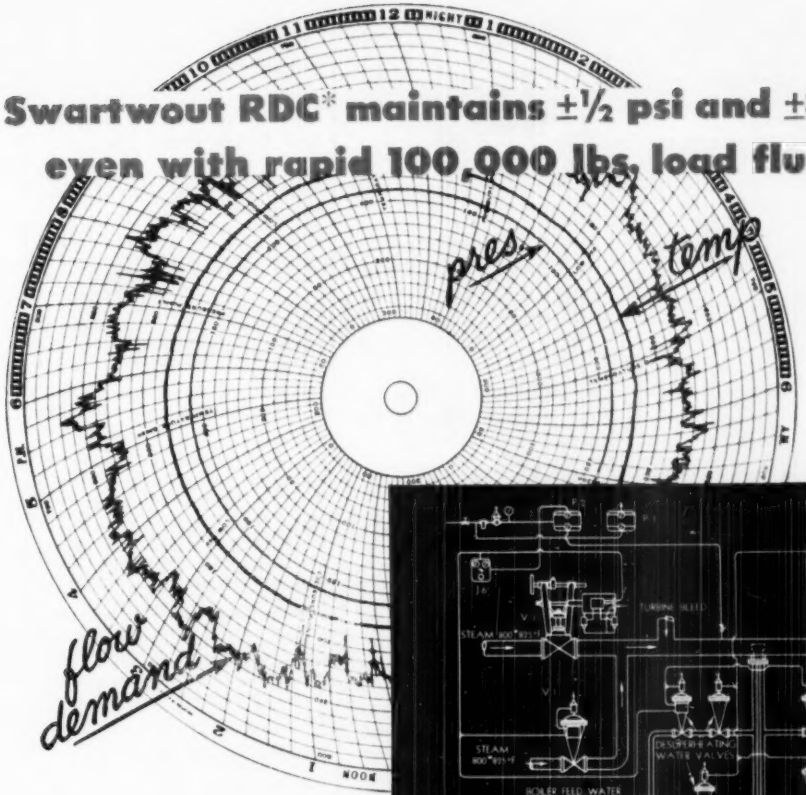
WEATHERPROOF FLOOD LAMP P1158

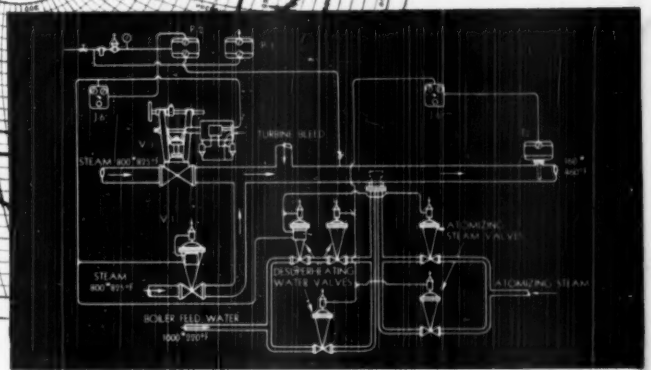
Hi-Flood is made of hard glass, which resists sudden temperature changes, moisture, vibration, and impact of flying insets. Lamp bases are nickel-plated to reduce corrosion and freezing in sockets.

Lamps are suitable for high- and low-bay lighting installations in steel mills, foundries, and wherever excessive dust, vapors and fumes make it difficult and expensive to keep fixtures clean. The built-in re-

For further data on above items use reply cards on page 192a, identifying your request with letter *P* and number

Swartwout RDC* maintains ±½ psi and ±3°F control even with rapid 100,000 lbs. load fluctuation

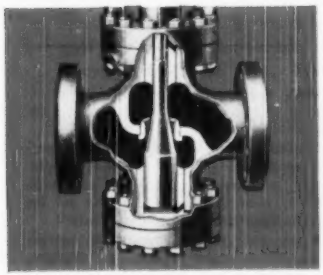




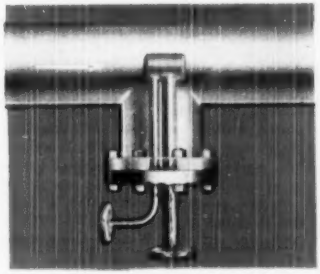
Swartwout

POWER PLANT EQUIPMENT

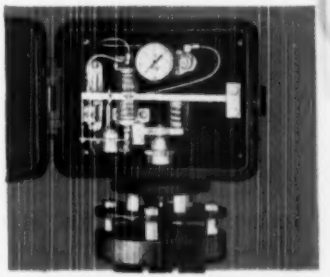
1 Swartwout RDC* system – Reducing, Desuperheating and Controls – handles fluctuating make-up load of up to 250,000 lbs. steam/hr. in a large Eastern paper mill. Initial conditions, 800 psi and 825°F; required final conditions, 160 psi and 460°F. Chart shows how Swartwout RDC system holds pressure to ±½ psi, temperature to ±3°F from minimum to maximum loads.



2 Swartwout V-1 valve *(above)* handles first 50,000 lbs. of load; V-3 then cuts in to handle 200,000 lbs. additional load. Valves reduce pressure from 800 to 160 psi without turbulence, vibration or undue noise. Correct design of disc, seat and throat eliminates high-velocity impingement and other destructive forces common to conventional reducing valves.



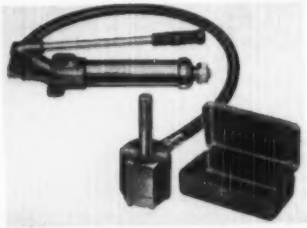
3 Swartwout steam atomizing desuperheater drops live steam temperature from 825°F, and varying extraction temperatures, to 460°F without pressure loss. Smooth-finished nozzle passages disperse atomized water outside head so that no erosion occurs. Narrow-angle atomization prevents thermal strains or cracks in piping, eliminates need for pipe liners.



4 Swartwout T2 direct-contact master control with reset for load compensation, sends temperature-proportional air-loading pressure through J-6 manual-automatic selector panel. Response to temperature change, within fraction of a second, assures precise temperature control regardless of load fluctuation or time lag.

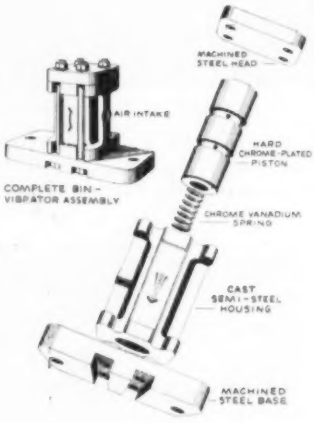
SEND FOR BULLETINS S-21-E, S-22-C, S-198 • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

flector of the R-60 lamps maintains their reflecting efficiency since the silver surface is on lamp's inner side.
Radiant Lamp Corp, 3000 Jelliff Ave, Newark 8, N. J.



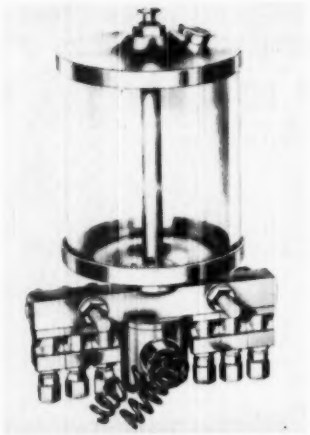
CONDUIT HOLE CUTTER P1143

Pump-operated device cuts ½-in. to 4-in.-size conduit holes in metals up to 10 gage. Cutters are standard type that have been associated with hand-operated knockout punches. This device simply replaces the bolt, hence eliminates a certain amount of hazard and manual labor.
Patterson Equipment Co, PO Box 163, Denair, Calif.



AIR-OPERATED VIBRATOR P1132

Type F vibrator is designed to move cinders, coal, sand, gravel, cement and other materials in fine or lump state that plug or arch in chutes, hoppers, bins, screens or storage tanks. Vibrator assembly is held together with 4 longitudinal body bolts and stop-lock nuts. Five parts are used—mounting base plate, housing, spring, piston and head.
The Cleveland Vibrator Co, 2824 Clinton Ave, Cleveland, Ohio.



MULTIPLE-FEED OILER P1151

Centralized system of lubricating 1 to 20 bearing points on machine tools, automatic machines, printing presses, conveyors, etc. Oil is fed by gravity from large reservoir through individually adjustable needle-valves, then through copper or neoprene tubing to various bearings.

When solenoid, located directly below reservoir, is energized, oil feeds to all lines. Feed stops when current is shut off. Electrical connections can be attached to any convenient outlet or directly across motor-starting switch. In the latter case, unit starts automatically when motor is energized.
Trico Fuse Mfg Co, 2948 N 5th St, Milwaukee 12, Wis.

PORTABLE WELDER P1106

Increased power, faster welding, easier handling, automatic switch control are reported features of new self-contained, portable spot welder, model BW. It weighs 33 lb, welds up to ¼-in. combined thickness of mild or stainless steel or two pieces of 16-gage galvanized metal with a combined thickness of ¼ in.
Greyhound AC Arc Welder Corp, 606 Johnsen Ave, Brooklyn 6, N. Y.

SQUIRREL-CAGE MOTORS P1148

Redesign of standard line of motors having four or more poles results in improved bearing-housing design along with more efficient tooling.

The split, cast-iron bearing capsule or housing has a machine flange for bolting to the bearing bracket. This permits removing upper half of bracket for inspection or cleaning without exposing the bearing inside.

Similarly, the ample air discharge openings on the side of the stator yoke are protected by removable louvers. This facilitates vacuum cleaning or blowing out the air passages behind the stator core.

Since the only openings in bearing brackets are in air intakes near the bottom, brackets afford effective protection for the motor ends. This construction, plus use of louvered panels in the stator air-discharge openings, makes the standard design drip-proof. Splash-proof motors with internal baffling of air passages are also available.
Allis-Chalmers Mfg Co, Milwaukee
(*Continued on page* 182)

Thumb Back a Few Pages And Check These Too . . .

Air Conditioner *for crane cabs and confined spaces in industrial plants. Will remove fumes as well* ..... *p 182*

Steam Trap *for draining sterilizers, laundry and dry-cleaning presses, etc* ..... *p 182*

Continuous Smoke Recorder *uses optical density of smoke deposit as measure of smoke content in flue stream* ..... *p 184*

Utility Pump *removes water from elevator pits, transformer and cable vaults, boiler rooms, etc.* ..... *p 186*

Electronic Flowmeter *especially designed for high-capacity measurement of abrasive liquids, gases, etc.* ..... *p 188*

Motor Valve *automatically operated by thermostats, pressurestats, liquid level, etc. Valve will handle steam, water, oil and gas* ..... *p 190*

Sealing Compound *that stays plastic* ..... *p 192*

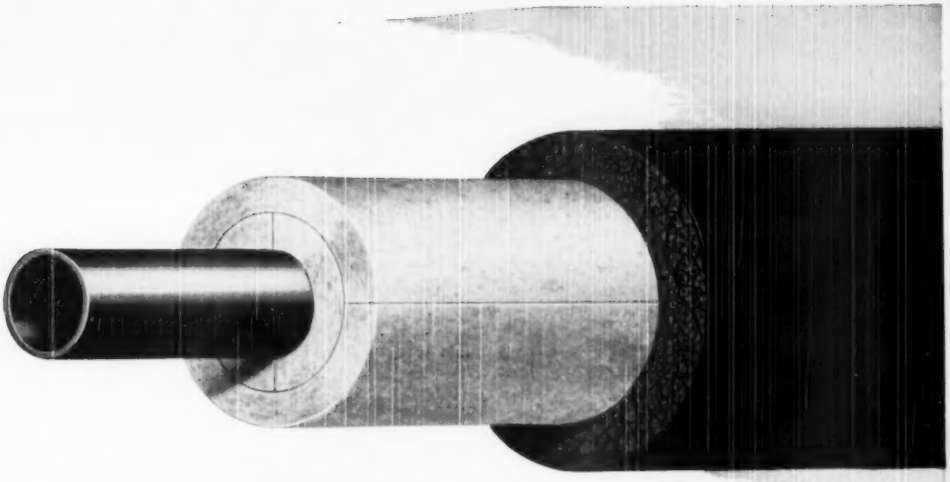
Angle Valve *with long sweep results in minimum turbulence. Well suited for control where solids may plug regular valve* ..... *p 192*

Instrument Fittings *that give a vacuum-tight seal. Two ferrules and a threaded chuck clinch tubing wall tightly. Fittings will hold heavy or thin wall tubing* ..... *p 192*

And Next Month . . .

Pump Sequence Control *automatically starts and stops pumps according to demand. Well suited for petroleum-fuel-loading terminals, and similar pumping installations*

For further data on above items use reply cards on page 192a, identifying your request with letter P and number



WE HAVE BEEN ASKED:

How do we insulate for line temperatures from plus 300° F. to 75° F. below zero?

Recently a manufacturer wrote us as follows: "In our new test room, we are piping in air at temperatures from 300° above to 75° below zero. Air at either temperature extreme may be put through the lines for periods of several weeks. How can we insulate to hold temperatures steady and cut refrigeration and heating costs?"

After studying the problem, we recommended a combination of 85% Magnesia and Armstrong's Cork Covering. These two materials, used together, will provide efficient insulation and yet take up little space.

High insulating efficiency will be supplied by the cork lagging. However, since cork should not be used for prolonged service above 180° F., it is necessary to bring the temperature at the hot surface of the cork covering below that point. Four inches of Magnesia in this specification will bring the temperature down to 165° F. when the line is carrying 300° air.

Over the Magnesia, 3" of cork covering will result in a heat gain of 3.8 Btu per sq. ft. per hour when the line is operating at the 75° below zero temperature. The cork covering also has the advantage of being easily vapor-proofed to prevent damaging moisture penetration when the line is operating at low temperatures.

An unusual problem like this cannot, of course, be solved by any simple rule of thumb. All factors must be analyzed and provided for. Armstrong's engineers are qualified by training and experience to give you the right answer. That's why it pays you to ask an Armstrong engineer about your insulation problem. He can furnish expert advice as well as the right insulating materials and skilled workmen to apply them.

SEND US YOUR QUESTIONS: If you have any questions on the use or application of either high- or low-temperature insulation, please do not hesitate to write to us. We'll do our best to give you a practical answer. Just address a letter or post card to Armstrong Cork Company, 7011 Maple Street, Lancaster, Pennsylvania.

ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS - INSTALLATION

FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2800°F.

Let's Stop Playing 'Grasshopper'

I'm referring to that old fable about the grasshopper who played all summer long in the meadows while his neighbor ants spent the time laboriously laying away food for the winter. Then when winter came, the grasshopper was out of luck, while the ants were sitting pretty.

What's that got to do with us? Well, take a look at the mad rush to get orders on the books for power equipment and supplies that's taken place since this Korean business hit us.

A plumbing-supply-salesman friend of mine says some of his customers have ordered more stuff since June 25 than they did in the two years preceding. Another friend who sells boilers has received orders saying, "Reserve me *a boiler*, will send size and pressure later."

Manufacturers' books are so full now that a good many people will wait months to have their orders filled. Yet many of these people need not have waited at all . . . if they'd only stopped playing grasshopper years ago.

Playing grasshopper means among other things carrying an insufficient stock of replacement parts, piping, fittings, valves and other supplies. It also means failing to establish a well-thought-out long-range program of plant improvement and expansion. Then when an emergency like Korea hits, the grasshopper starts rushing like mad to get the things he could have and should have gotten months ago. It's an old story.

I've been harping on this grasshopper business for years. It's the same type of thinking that people use who don't practice maintenance until it's darn near impossible to get. When the government takes over allocation of new equipment before many rush orders get filled—as they may very well do—I only hope those of us who get caught short will learn a lesson from it.

In the future, try a little more thinking, establish a long-range program of machinery replacement and keep enough supplies on hand to meet emergencies *before they hit*.

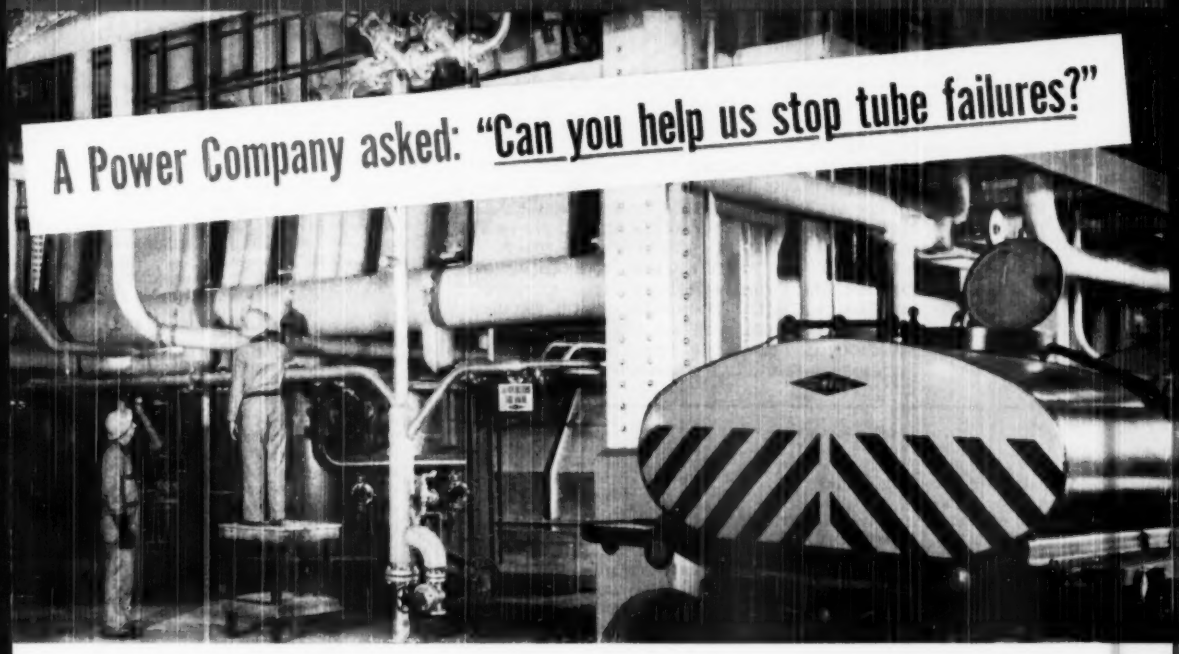
George Edwards

Engineer

P. S. Engineers who practice the other extreme and are stockpiling materials far above their needs may also learn a lesson from the government's proposed inventory control.

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS



A Power Company asked: "Can you help us stop tube failures?"

Dowell Service provided a fast, effective solution!

A midwestern power and light company, operating 350,000 lb. per hour steam generators, was having numerous unscheduled shutdowns because of tube failures. Although tubes were turbined periodically and inspections showed that deposits were small in amount, tubes continued to blister. A crisis was reached when 11 outages occurred in 18 days!

Dowell Service provided the answer with a *more effective, faster and more economical* method of maintenance cleaning. Tube failures at this power house have been practically eliminated. A regular cleaning schedule using Dowell Service has solved similar problems in many other plants.

What is Dowell Service? Experienced engineers fill the equipment to be cleaned with special liquid solvents designed to dissolve and disintegrate the profit-stealing deposits from all surfaces, even the most complex, *in a few hours.* The solvents are carried to the job in Dowell pump trucks and are pumped into the unit through regular connections. There is no dismantling.

Call Dowell for consultation on your cleaning problems. A Dowell engineer is as near as your telephone. No obligation, of course.

Other recent Dowell jobs:

Anthracite filters cleaned by Dowell Service in one working day. Backwash rate increased from 75 to 385 g.p.m.

★

Five air conditioning compressors cleaned for office building in 8 hours by Dowell Service. Result: $15.70 per day saved on power demand.

★

Two 40,000 lb./hr. boilers cleaned for paper company in 24 hours. Result: 37 tons of fuel per day saved under same load conditions.

CALL

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Wilmington 99	Chicago 2	New Orleans 12	Borger, Texas
Richmond 19	St. Louis 8	Ft. Worth 2	Midland, Texas
Jacksonville	Indianapolis	Shreveport 69	Wichita Falls, Texas
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Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

A SERVICE ORGANIZATION

ENGINEER'S BOOKSHELF

REVIEWED IN THIS ISSUE

STEAM TURBINES AND THEIR CYCLES • LIQUID METALS HANDBOOK
HEATING, VENTILATING, AIR-CONDITIONING GUIDE
INTEGRATED POWER SYSTEM • MOTOR OILS AND ENGINE LUBRICATION
PROPERTIES OF METALS AT ELEVATED TEMPERATURES • DC MOTOR MANUAL
INDUSTRIAL INSTRUMENTATION • LEXIQUE TECHNIQUE ANGLAIS-FRANCAIS
INTRODUCTION TO TRANSFER OF HEAT AND MASS • EQUIVALENT VALVES
STRENGTH OF WROUGHT STEELS AT ELEVATED TEMPERATURES
INDUSTRIAL HIGH-FREQUENCY ELEC POWER • MAKING CAPITALISM WORK
ASTM SPECIFICATIONS FOR STEEL PIPING MATERIALS—STEEL FLAT PRODUCTS
HANDBOOK OF INDUSTRIAL WATER CONDITIONING • OUR OIL RESOURCES
STEEL-CASTINGS HANDBOOK • METALS AND ALLOYS
PROCEDURE HANDBOOK OF ARC-WELDING DESIGN AND PRACTICE
CIRCUITS IN ELECTRICAL ENGINEERING

Economic Policy

MAKING CAPITALISM WORK (1950). *By Dexter Merriam Keezer and associates of the Dept of Economics, McGraw-Hill Publishing Co.* 316 *pp, tables, charts,* $3.50. *McGraw-Hill Book Co,* 330 *West* 42*nd Street, New York* 18, *N. Y.*

POWER's book notes normally deal with direct technical concerns of power engineers. Yet what can be of greater concern to all of us than the full development of a way of life that has made us strong and prosperous? Here is a book that not only tells why capitalism is the most productive economic system ever devised, but also sets down in clear terms requirements to meet if it is to have a thriving U.S. future.

Without mumbo jumbo, the authors discuss these several points in detail: (1) providing essential tools and equipment necessary to effective utilization of our resources (2) assuring vigorous utilization of these resources (3) seeing that the proceeds of industry are fairly divided (4) protecting the economy from violent disruptions (5) providing enough individual economic security to remove destructive fear (6) producing the economic foundations for a rising standard of well-being (7) treating our resources with regard for the needs of generations to come, and (8) creating a tolerably congenial political and social environment for capitalism by successfully demonstrating its compatability with basic American ideals.

In doing this, the authors advance a program for general tax revision, outline steps needed to restore incentives, meet demands for social security and social welfare, maintain effective competition and safeguard our natural resources.

Steam Turbines

STEAM TURBINES AND THEIR CYCLES, *by J Kenneth Salisbury, General Electric Co.* 645 *pp,* 9¼x6, *illust, tables,* $9. *John Wiley & Sons, Inc,* 440 *Fourth Ave, New York* 16.

Here are facts of practical importance to station designers presented by an authority in the field of steam-turbine design. The information is divided into four principal parts, I—Fundamentals of Turbine Design, II—The Regenerative Cycle, III—Cycle Analysis, IV—Application Engineering.

Elements of thermodynamics pertaining to steam plants are reviewed before considering the design of turbine elements in detail. These factors are discussed in considerable mathematical detail with examples. A few of the items explored include nozzle and bucket areas, stage areas, area ratio-reaction relationship, practical nozzle-bucket efficiency, packing leakage, supersaturation loss, nozzle end loss, exhaust loss, etc.

All aspects of the practical regenerative cycle are explored. Almost half the book is devoted to this important aspect of turbine design. Heat-balance practice and calculations are covered in a complete manner. The author derives a method for studying all types of heat cycles, which considerably reduces the amount of labor expended by the station designer in arriving at an economical arrangement.

Under application engineering, various types of turbines are shown. Extensive curves and tables are included for figuring turbine steam and heat rates.

Power Systems

THE INTEGRATED POWER SYSTEM, *by Philip Sporn, President, American Gas and Electric Service Corp.* 157 *pp,* 8¼x5¾, 28 *illust,* $4. *McGraw-Hill Book Co,* 330 *West* 42*nd St, New York* 18, *N. Y.*

A short treatise on regional power systems with specific reference to the American Gas and Electric System. It discusses basic principles, components, economic advantages and disadvantages as well as limitations of integrated power systems as a means of power supply. The book is primarily for the layman, giving no fundamental technical discussions of equipment.

The various chapters cover topics such as: fundamental social-economic objectives of an integrated system, technical requirements, components, tools for coordinating personnel, interconnections, example of a system.

Heat Transfer

INTRODUCTION TO THE TRANSFER OF HEAT AND MASS, *by E R G Eckert, Air Material Command, Wright Patterson Air Force Base, and Consultant, National Advisory Committee for Aeronautics.* 284 *pp,* 9¼x6, 143 *illust, tables,* $4. *McGraw-Hill Book Co,* 330 *W* 42*nd St, New York* 18, *N. Y.*

This is a graduate course in heat transfer. It is a translation and revision of an earlier German text by the same author. He proceeds to develop the subject from basic theory and shows how to check it experimentally. Foundation of the analysis is the boundary-layer theory by L Prandtl and the dimensional analysis introduced by W Nusselt. Approximate solutions using the momentum equation and the analogous heat- and mass-flow equations are employed in the book.

Laminar heat transfer is covered more completely than usual because interest is rising in occurrences within this range. Heat-transfer processes in airplanes and missiles at high altitudes take place in this range.

Group topics covered include fundamental principles, conduction, convection, flow theory, forced convection in laminar flow, forced convection in turbulent flow, free convection, condensation and evaporation, emission of thermal radiation, heat exchange by radiation, exchange of mass.

Heating, Air Conditioning

HEATING, VENTILATING, AIR-CONDITIONING GUIDE, 1950 *edition,* 1420 *pp,* 6x9, *illust, cloth;* $7.50. *American Society of Heating and Ventilating Engineers,* 51 *Madison Ave, New York* 10, *N. Y.*

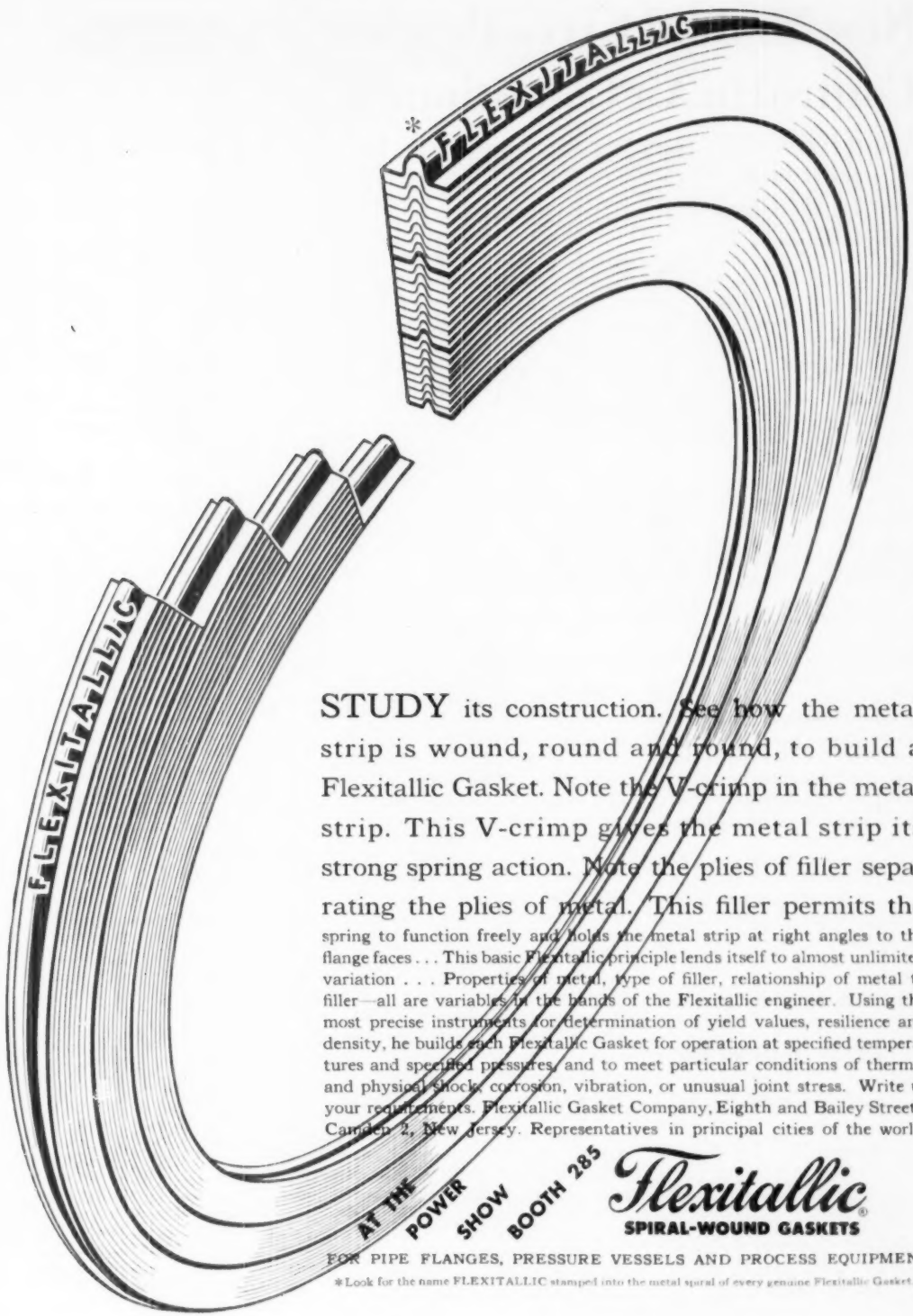
The Guide has become an almost indispensable aid for operators, designers and purchasers of heating, ventilating or air-conditioning plants. This, the 28th edition, has 1024 pages in the Technical Data Section and 396 for a Manufacturers Catalog Data Section.

A thorough revision of the technical data was made by the 34 contributors as well as other authorities who were asked to comment on the assembled material. The ASHVE Comfort Chart, for instance, has been revised to agree with the latest society and cooperative research findings.

Chapter on Heating Load has been enlarged by addition of a section on floor-heat losses in basementless houses. A formula is given for computing heat loss from the perimeter of various typical floors in these basementless homes.

Fuels and Combustion section includes new data on fuel specifications. Latest anthracite sizing is given as well as new

(*Continued on page* 166)



STUDY its construction. See how the metal strip is wound, round and round, to build a Flexitallic Gasket. Note the V-crimp in the metal strip. This V-crimp gives the metal strip its strong spring action. Note the plies of filler separating the plies of metal. This filler permits the spring to function freely and holds the metal strip at right angles to the flange faces . . . This basic Flexitallic principle lends itself to almost unlimited variation . . . Properties of metal, type of filler, relationship of metal to filler—all are variables in the hands of the Flexitallic engineer. Using the most precise instruments for determination of yield values, resilience and density, he builds each Flexitallic Gasket for operation at specified temperatures and specified pressures, and to meet particular conditions of thermal and physical shock, corrosion, vibration, or unusual joint stress. Write us your requirements. Flexitallic Gasket Company, Eighth and Bailey Streets, Camden 2, New Jersey. Representatives in principal cities of the world.

AT THE POWER SHOW BOOTH 285

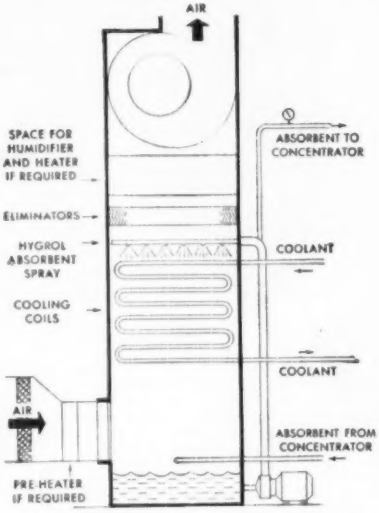
Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket.

New Method Gives Precise Control in Air Conditioning

Niagara "Controlled Humidity Method" Uses Hygrol, Hygienic Liquid Absorbent



NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

● The Niagara "Controlled Humidity Method" is a new system of air conditioning giving complete control of temperature and relative humidity, holding constant conditions or varying them at the will of the user. Especially, it provides dry air at normal atmospheric temperatures with little or no refrigeration required. A condition of 15 grains of moisture per pound of air at 85 deg. F. dry bulb temperature has been produced without refrigeration.

The apparatus is enclosed in a casing thru which the air is drawn by fans. The air is filtered and then enters a chamber where it is dehumidified in passing thru a spray of "Hygrol" Liquid (a hygienic hygroscopic chemical that absorbs the air-borne moisture and contains no salts or solids to precipitate) In the same chamber are located cooling coils which remove the latent heat of evaporation and also sensible heat as required.

The absorbent liquid spray falls into a tank at the base, where it is piped to a concentrator, removing moisture taken from the air. The re-concentrated liquid returns to the system. This process is continuous, and the apparatus operates at full capacity at all times.

The same equipment may be used to provide winter air conditioning when required, by installing a tempering coil at the outdoor intake, an humidifier, and a reheat coil above the eliminators.

This equipment is manufactured in a range of sizes providing from 1000 to 20,000 CFM of conditioned air from a single unit, and mutiple unit installations are practical. It is expected that, by reducing the need for refrigeration, the cost of air conditioning will be reduced by this method. Applications generally are in a temperature range from 35 deg. F. upward. Below the freezing temperature of water, the Niagara "No-Frost" method is applicable.

The equipment is protected by U. S. and foreign patents. Installations have been made in food and chemical process industries, in packaging hygroscopic products, for preventing condensation of moisture on metals and other products in storage, in air conditioning for laboratory control and for human comfort.

For further information, write Niagara Blower Company, Dept. P. 405 Lexington Ave., New York 17, N. Y.

See this new method at

"THE POWER SHOW"

Booths 23 - 24 - 25

Nov. 27 to Dec. 2, 1950

Grand Central Palace

New York City

(advertisement)

ELECTRONICS

(*Continued from page 126*)

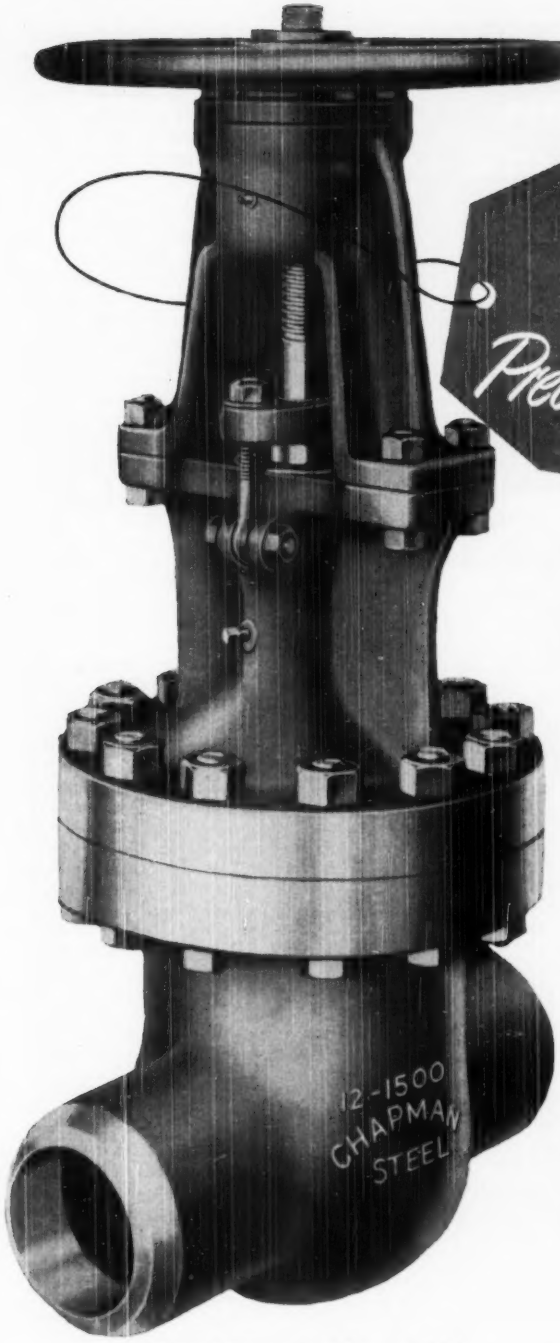
potentiometer *MP* is applied from grid to cathode of tube T_{3}, and it conducts a low current only. So grid bias is low on T_{3}, and it supplies full current to the dc coils of the saturable reactors. As a result the power-rectifier tubes are ready to conduct full power as soon as anode contactors close and energize the magnetic drive.

Assume potentiometer *MP* is set for an intermediate speed and voltage of ST_1 is toward the common connection *Y*, as arrow indicates. Current then flows from *Y* to the ring on the magnetic drive, through the coil to the + ring and to CT on the cathode-heating transformer, to the cathode and anode of tube T_1 to ST_1. The other tubes fire in numerical order and the magnetic drive accelerates its load to the speed set by potentiometer *MP*.

When contacts UV_2 and UV_3 close, protective time-delay relay coil *TDR* is energized through low-voltage relay contact *LV*, transfer-relay contact TR_1 so that relay *TDR* starts timing out. Low-voltage relay coil *LVR* is energized from *Y* on the power rectifier through coil *LV* to ground and to ground tap on transformer coil on S_1 to the rectifier tubes. Voltage across coil LVR reaches about 25 or 30 almost instantly. Contact *LVR* opens to break the timing relay's circuit and it resets so that the auxiliary control remains isolated and inactive. High-voltage relay operates when the voltage rises to about 125% of normal. We will discuss the function of these relays later.

Assume the drive operating at an intermediate speed. Voltage is applied by tachometer generator TG from its — terminal through part of potentiometer *MP* and part of R_1 to cathode and grid of T_3, and to the speed and voltage stabilizer. Here the circuit is completed up through winding SV_2 and resistor R_7 and through SV_3 to + on *TG* to give the grid of T_3 plus bias. If the potentiometer is turned counterclockwise to a new position calling for higher speed, full excitation will be applied to the drive's field coils and it will rapidly come up to the new speed. As it approaches this speed, excitation falls quickly. It then increases slightly and the drive settles down at the proper speed without overrun.

If the potentiometer is moved to a position calling for lower speed, excitation is removed entirely from the drive's field coils. As the proper speed is approached low excitation is applied to the fields coils to prevent overrun. Low speed will stabilize at the desired value. Sensitivity of the speed control is such that a change of 0.003 v in the tachometer generator voltage causes a swing to



Flanged bonnet, welding end, high pressure, gate valve.

WHEN YOU WANT

BOTH Precision and Economy

Specify CHAPMAN STEEL VALVES

Want valves with precision ratings that equal or exceed standard specifications? Then specify Chapman Valves. You'll find them the equal of custom-made valves *every time.* Yet they are economical — with the economy that comes from production line manufacture.

You'll find it will pay to specify Chapman valves for every power plant need . . . for longer service, for better service, for lower maintenance.

Available in three types of body and bonnet connections — welded, pressure sealed or flanged. Also in gate, globe, angle, or check types. Welding end valves available in globe as well as in tilting disc styles.

The Chapman Valve Mfg. Co.
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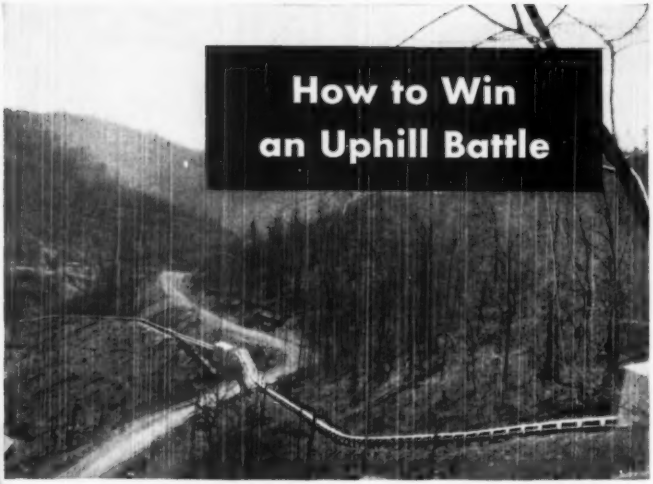

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either zero or full excitation volts on the magnetic drive, depending on whether speed is high or low.

Speed and Voltage Stabilizer. During operation the speed and voltage stabilizer prevents change in speed unless called for by change in position of the potentiometer's arm. Even when change in speed is called for by change in position of arm *AP*, the speed and voltage stabilizer opposes the change to prevent hunting or overrun.

For example, in Fig. 3 if arm *AP* moves counter-clockwise to increase the speed it decreases the voltage from cathode to grid of tube T_9. This action reduces the bias on tube T_{10} to increase excitation of the magnetic drive. The drive speeds up and tachometer generator's voltage rises to increase the current through primary winding PV_1 of transformer TV_1 as indicated by the arrow. A voltage is induced in the secondary SV_1 of this transformer as shown.

Current increases in primary PV_2 of transformer TV_2 because of increased excitation to the magnetic drive. Increased current in primary PV_2 induces a voltage in its secondary in the direction shown by the arrow. These two secondary voltages are in series with the tachometer generator *TG*. From the secondary of SV_1, the voltage is through *TG* to *MP*, from cathode to anode of T_9, through secondary SV_2, back to SV_1. We assumed that arm *AP* was moved to reduce voltage from cathode to grid and thus to increase the speed. But action of the increased excitation to the magnetic drive and increased speed of the tachometer generator, produced voltages in secondaries of the speed-and-voltage stabilizer to maintain the potential on T_9 cathode and grid to oppose the speed increase. As a result, speed increases quickly without overrun, to that called for by new setting of potentiometer. After speed is established it will be held within $\pm$ 0.5% regardless of reasonable line voltage or load variations.

In the speed-and-voltage stabilizer note transformers are connected so voltage arrows on the secondary are in the same direction as on the primary. This is the opposite to that we usually assume. In most circuits it makes no difference which polarity is assumed. Here it does because of the relation of the secondary's polarity to that of the tachometer generator. Also, note direct current is in the primaries and voltage is induced in the secondaries only when current increases or decreases in the primaries.

Voltage Relays. During normal operation of the control, low-voltage dc relay *LV* and high-voltage *HV* keep a constant watch over operation. For example, with load speed at 50% rpm as-

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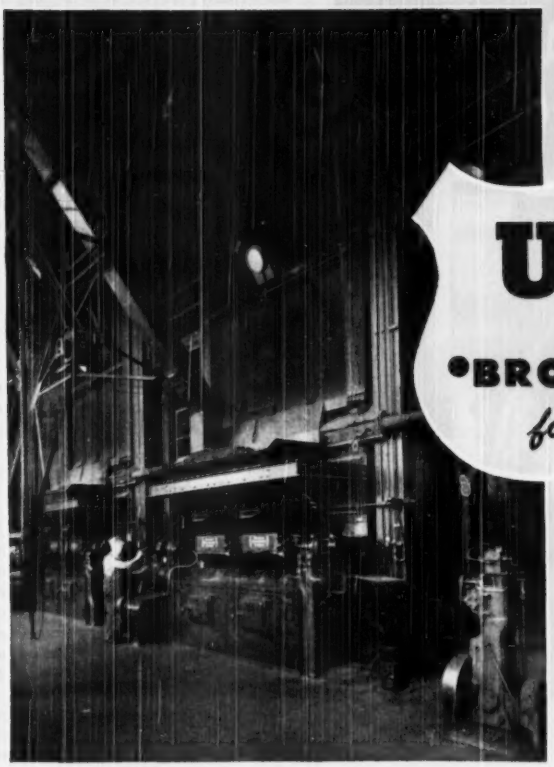
sume potentiometer *MP* suddenly calls for 90% speed. Action of the potentiometer is to increase the power rectifier's output voltage to 125% rated value to increase the speed immediately. Because of the high output voltage relay *HV* pulls in and closes contact *HVR*. A circuit for *HV* coil is from the center tap *Y*, through *HV*, to ground, to center tap on secondary S_1 and to the cathodes of whatever power tubes are firing.

When *HVR* contact closes, red warning lamps *RL* light, and timing relay *TDR* starts to time out. In a few seconds the magnetic drive reaches 90% speed and relay *HVR* drops out as excitation voltage falls below 100%. At the same time the red warning lights go out and the timing relay resets. For reduced speed the low-voltage relay acts in the same way. If the potentiometer calls for lower speed, excitation voltage is off until just before the new speed is reached.

When Automatic Control Fails. Failure of any part ahead of the power-rectifier tubes, such as the tachometer generator, amplifying tubes or main potentiometer, causes either full or zero saturation of the saturable reactor in the power-tube control circuit. Then, either full or zero excitation is applied to the magnetic drive and either high-voltage or low-voltage relay functions to close the circuit of time-delay relay *TDR*. This relay is usually set to time out in 15 sec to close contact TD_2 and complete the circuit for transfer relay coil *TR*. This relay's contact TR_2 closes to form a holding circuit around contact TD_2 and hold the transfer relay closed when contact TR_1 opens the time-delay coil's circuit.

The transfer relay also opens contact TR_3 and closes TR_4. Opening the former disconnects potentiometer *MP* and amplifying tubes T_5 and T_6 from the power-rectifier grid control. Closing contacts TR_4 connects the auxiliary potentiometer directly to the dc coils of the saturable reactors in the power rectifier grid-control circuits. Now output-speed control of the magnetic drive has been transferred to the auxiliary potentiometer, and speed is under manual control only and is not regulated for load changes. Power for the auxiliary control is supplied from rectifier *GR4*. After transfer relay *TR* has switched the speed control to manual, it can be changed back to automatic only by pressing the reset button, which breaks the transfer-relay coil's circuit.

Auxiliary Control. Control of the magnetic drive can be put directly on auxiliary control by closing the transfer switch to the top of auxiliary contact. This connects the transfer-relay coil directly across the line where it stays until the switch is again closed to the



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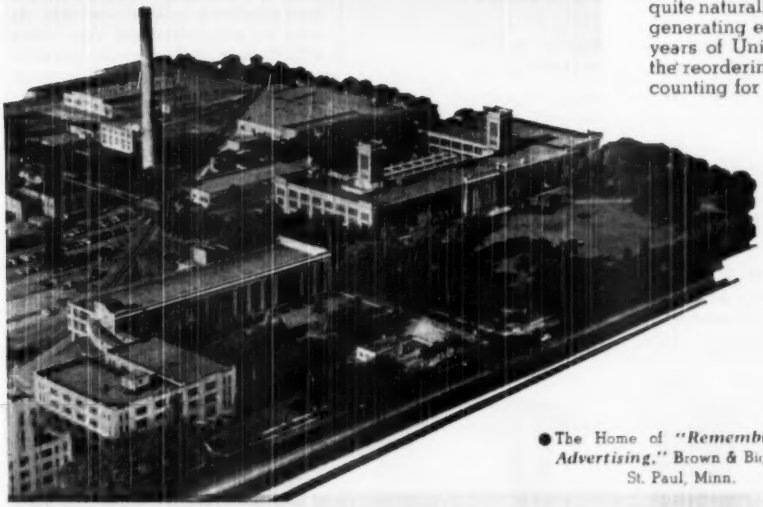

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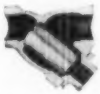

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main control contact, as in the diagram.

Cushion inductors and cushion circuits have nothing to do with the controls' operation as such. They are protective devices to limit the rate of inverse voltage rise on the 6-phase rectifier tubes so they will have long life.

There are many other interesting features of this intriguing control that we might study if space permitted. But with the background of circuit given, the reader should be able to investigate any other functions he may desire.

REFRIGERATION

(*Continued from page* 101)

perature change, compressor starting, liquid temperature, head pressure and refrigerant leakage. Let's see how these controls stack up.

Fouled tubes. In all these controls fouled tubes increase water quantity to condenser. Reduced heat transfer in condenser raises head pressure. As fouling becomes worse, water valve opens until it allows maximum flow. Further fouling causes head-pressure increase. When this occurs operator knows condenser needs immediate cleaning. Water wastage is about same in all systems except Fig. 3 where it may be greater.

Air-bound condenser. Air in condenser raises system pressure and has same effect as high head pressure. Water valve opens to admit more water, and head pressure is reduced somewhat. As more air accumulates and valve opens fully there is no decrease in condenser pressure. Only way to reduce water flow with air-bound condenser is by purging. Water valve in Fig. 5 opens more rapidly than in other controls, and temperature-sensitive element in Fig. 3 does not compensate pressure control when condenser is air bound.

Inlet water. Water-inlet temperature changes with weather and other conditions. With low inlet temperature all controls except Fig. 5 prevent head pressure from decreasing appreciably. Automatic reduction of water flow prevents wastage. Differential-temperature control, Fig. 5, allows slight increase in head pressure and, at the same time, saves water.

Excessive water quantities may be used by controls in Fig. 3 and 5 when inlet temperature is high. With liquid-temperature compensation, Fig. 3, use of more water is often justified on basis of increased capacity at existing temperature. Other controls prevent abnormal head pressure by increasing water flow.

Compressor starting. Since pressure-sensitive control is used in all these systems, starting is easy. Water flow be-

Bucket of Trouble

Theoretically, water is composed only of hydrogen and oxygen—but the water which industry must actually use is a veritable storehouse of other substances.

It may contain inorganic impurities—ions of calcium, magnesium, sodium, iron, chloride, bicarbonate, sulphate, silicate or others less common; also organic contaminants, both living and lifeless—bacteria, algae, diatoms and other organisms; sewage or industrial waste. Both organic and inorganic matter may be present as suspended solids.

Analysis of the water will tell you only what it is—plant operations determine how and when to treat the water to obtain what you need. What should be done to the whole water supply, what to water used only for power, for cooling or for process? The problem can be stated simply, but dozens of interrelated factors must be considered in arriving at the best solution.

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gins as soon as head pressure is sufficient to open water valve.

Compressor discharge pressure. As we said earlier both minimum and maximum discharge pressures are important. Variations above or below these values are prevented by selection of a pressure-sensitive element suitable for the allowable range.

Refrigerant leakage. Proper head pressure is maintained in these systems by reduction of water flow during loss of charge. When charge is so low compressor can't raise head pressure to operate pressure-sensitive element, water valve closes.

Uses. Now let's pinpoint best uses for each system. We can't list all but we'll include the most important.

Pressure control, Fig. 1 and 6: For compressors with head pressures in the normal range of reciprocating units.

Pressure control with motorized valve, Fig. 2: For compressors with low head pressures.

Pressure control with liquid-temperature compensation, Fig. 3: For refrigerants whose liquid temperature affects system capacity.

Pressure control with cooling-water temperature compensation, Fig. 4: Where good economy is desired.

Pressure control with differential-temperature compensation, Fig. 5: Good where head pressure must increase with cooling-water temperature differential.

Compressors and condensers operated in parallel, Fig. 7 and 8: Use as suggested in text.

Small units, Fig. 9: Good for compressors up to about 5 hp.

Remember, some of these controls may be supplied with the compressor or condenser by the manufacturer. So check with him before purchasing one.

BOOKSHELF

(*Continued from page* 152)

fuel-oil specifications, grades and calorific values.

Added to the previous list in the chapter, Codes and Standards, are many new Codes and Standards of interest to heating, ventilating and air-conditioning engineers.

PROPERTIES OF METALS AT ELEVATED TEMPERATURES, *by George V Smith, research laboratory, U. S. Steel Corp of Delaware.* 401*pp*, 9¼x6, 238 *illust, tables,* $7. *McGraw-Hill Book Co,* 330 *West* 42*nd St, New York* 18, N. Y.

Here is a comprehensive summary of available information on the behavior of metals at high temperatures. Metals are discussed from the metallurgical point of view in regard to plastic deformation and fracture at ordinary and high temperature. Test apparatus and procedures for evaluating metals at high temperatures are studied.

Information has been summarized on the effects of variables such as chemical composition, manufacturing procedure and heat

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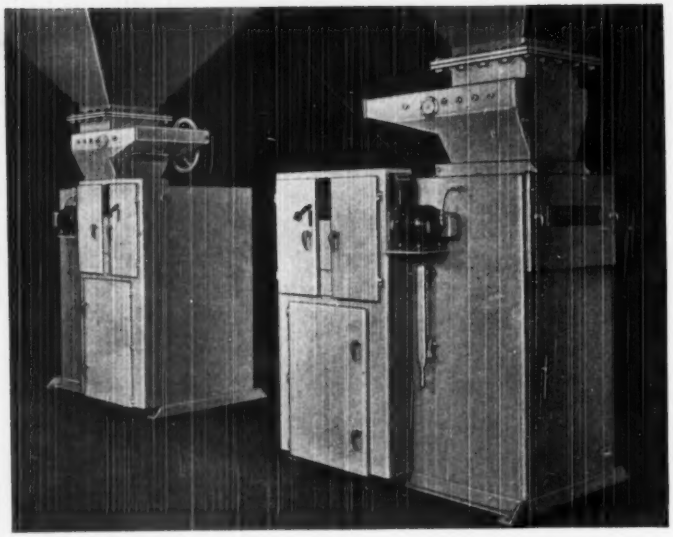

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treatment. Scaling of metals and the nature of changes in microstructure to be expected of metals in service are reviewed. A brief last chapter covers the characteristics that should be considered in designing applications of metals for high temperature. Included is an extensive bibliography of 488 references.

INDUSTRIAL INSTRUMENTATION, *by Donald P Eckman, College of Engineering, Cornell University. 396 pp, 8¾x5½, illust, tables, $5. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

Development of industrial methods brought the subject of measurement to the status of a science of its own. Its scope has extended far beyond elementary concepts of temperature and pressure determination. Measurement methods based on new and old physical relationships are becoming common in industrial operations.

The book reviews principles of measurements employed in industrial manufacturing. Many of those discussed do not fit the power-generation field, but the majority do. Emphasis of the discussion is placed on the method rather than the mechanism. In most instances the fundamentals of physical laws applying to a particular instrument have been reviewed.

Measurements and instruments dealt with are expansion thermometers, thermoelectric temperature methods, resistance thermometers, radiation temperature measurement, composition analysis, mechanical measurements, pressure and vacuum, head and level, flowmetering, process instrumentation.

ASTM SPECIFICATIONS FOR STEEL PIPING MATERIALS, *6x9, 328 pp, paper. $3. Published by American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

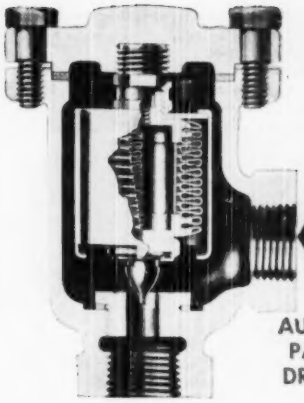
This latest edition of ASTM Standards on steel piping materials, as of December 1949, the book having come off press March 1950, includes some 50 widely used specifications. Materials covered include: (1) pipe used to convey liquids, vapors and gases at normal and elevated temperatures (2) still tubes for refinery service (3) heat exchanger and condenser tubes and (4) boiler and superheater tubes. Also included are specifications for castings, forgings, bolts and nuts used in pipe and related installations.

Sixteen specifications cover seamless and welded materials, both carbon and alloy grades. Thirteen standards cover boiler, superheater and miscellaneous tubes, including stainless tubing for general service and sanitary use. Other specifications include refinery, heat exchanger and condenser applications.

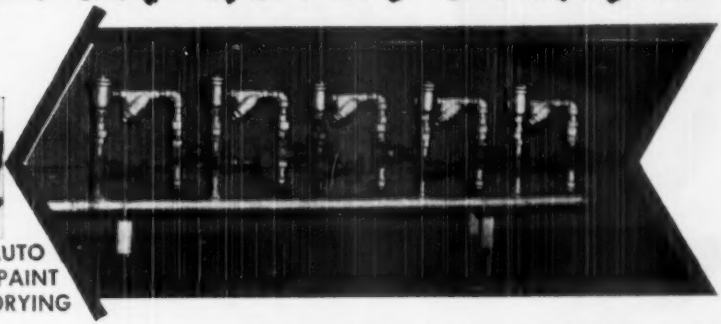
This publication is made more complete and usable by the Grain Size Standard E 19 and also by the American Standards covering steel and iron pipe (B 36.10) and the latest stainless-steel document (B 36.19).

"BETZ HANDBOOK OF INDUSTRIAL WATER CONDITIONING," *3rd edition, 198 pp, 8¼x10¾, illust, paper: $2. WH&LD Betz, Gillingham and Worth St, Philadelphia 24, Pa.*

Completely revised, rewritten and enlarged, this Handbook will be extremely



FOR QUICK STARTS



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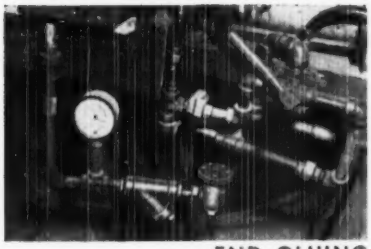

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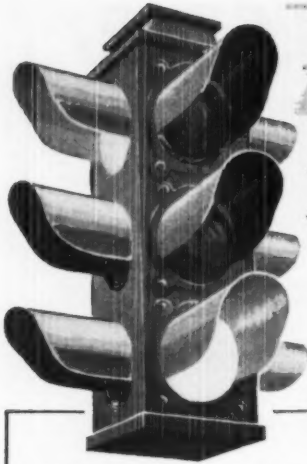

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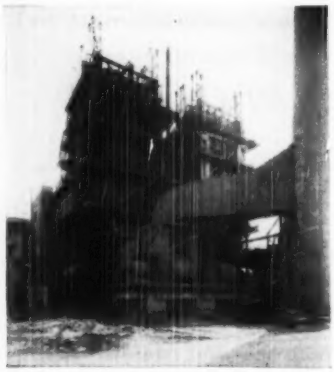

The Line of Green Induced and Forced Draft Fans includes many types in many sizes which are described in Bulletin No. 168. We shall be glad to discuss your fan requirements with your own engineers, with your consulting engineers and with the boiler manufacturer of your choice.

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useful to thousands of power engineers. Treatment is technical without being necessarily high brow.

Among the subjects the 32 chapters cover are: aeration, subsidence, coagulation, filtration, various softening processes, silica removal, scale formation, corrosion, embrittlement, cooling-water systems, etc.

The book is well organized, and, therefore, suitable both for study and reference. It is printed in two colors, and includes numerous graphs, tables, drawings and photographs. In addition to a fundamental treatment of some of the whys behind industrial-water treatment a considerable amount of suggested testing equipment is described.

LIQUID-METALS HANDBOOK, *by Atomic Energy Commission, Dept of the Navy, 194 pp, 7¾x10¼, illust, paper, $1.25. Supt of Documents, U. S. Government Printing Office, Washington, D. C.*

Since liquid metals may be used as coolants in nuclear chain reactors producing power, the fundamental information is of particular interest to reactor designers. Publication of the Handbook is, however, expected to encourage use of liquid metals in other industrial applications and thereby increase the number of technical personnel trained to work in this relatively new field of technology.

Much of the information was obtained during the last few years from research sponsored by the Atomic Energy Commission and two Navy Dept agencies, although private industrials have also contributed.

Information is compiled on metals having low melting points so they become liquid at room temperature or within a few hundred degrees of room temperature.

There are some seven chapters in all, covering physical and chemical properties, availability, handling, industrial utilization, heat transfer, effect on other metals.

ASTM SPECIFICATIONS FOR STEEL FLAT PRODUCTS, *by ASTM Committee A-1 on steel, March 1950, 204 pp, 5¾x9, illust, paper. $2.25. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

This compilation includes 39 specifications for steel flat products—plate, sheet, strip and related materials. These materials have a wide use for structural purposes and for boiler or pressure vessels. For convenience a number of the tsandards relating to stainless steel, wrought iron and metallic coated sheets are given also.

These specifications are reprinted from the 1949 Book of ASTM Standards to provide the flat steel data in a compact form.

EQUIVALENT VALVES, *Compiled by H Gordon Hawes, 8½x11, indexed, many tables, loose-leaf binder. $15. Hooper Publishing Co, 545 Sansome St, San Francisco, Calif.*

This list of equivalent valves is basically a guide to differences between valves offered by 18 manufacturers. It is useful to engineers, purchasing agents, salesmen and specifications writers.

The list is broken down by material, valve type and catalog pressure rating.

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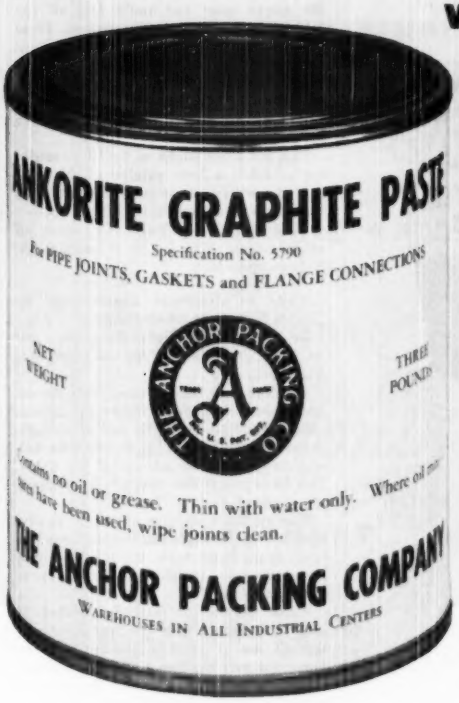
ANKORITE GRAPHITE PASTE
Specification No. 5790
For PIPE JOINTS, GASKETS and FLANGE CONNECTIONS
NET WEIGHT
THREE POUNDS
THE ANCHOR PACKING CO
Contains no oil or grease. Thin with water only.
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KORITE PIPE JOINT COMPOU
(Ever Fresh)
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ONE QUART
THE ANCHOR PACKING CO
an effective seal on threaded joints and various equipment
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This paste is recommended for sealing screw threads and flange joints on steam, gasoline, kerosene, vapor, creosote, tar, hot oil, air and acid lines. Its variety of uses includes cylinder heads, internal combustion engines, turbines, rotary motor pumps, generators, and oil burning equipment.

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. . . is a screw thread and gasket joint compound made by The Anchor Packing Company to seal all water, gas, steam and air line joints. There is never any waste, and the compound never spoils. Linseed or lubricating oil is used for thinning.

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Circuits in Electrical Engineering, by Charles R Vail, Assistant Professor of Electrical Engineering, Duke University, 560 *pp,* $7.65. *Prentice-Hall Inc,* 70 *Fifth Ave, New York, N. Y.*

Tradition has long decreed that formal study of electric-circuit theory be divided into separate studies of dc and ac circuits. Result has often been insufficient time and emphasis on the ac portion of the study. This book avoids this difficulty by unifying the study of electric circuits.

This approach provides one set of steady-state circuit principles sufficiently broad to apply to all frequenceis, including the zero frequency case commonly referred to as direct current.

Major portion of book is devoted to study of steady-state circuit principles through use of complex numbers. But an important part includes a study in terms of instantaneous values of sinusoidal and non-sinusoidal wave relations.

DIRECT-CURRENT MOTOR MANUAL, *by H S Dusenbery,* 275 *pp,* 8½x6½, $3.50. *The Macmillan Co,* 60 *Fifth Ave, New York* 11, *N. Y.*

This book is for those concerned with selection, installation, operation and maintenance of dc motors and associated control equipment. Elements of design are touched for those interested in making minor equipment modifications.

Starting with basic principles of dc-motor operation, the author discusses each of the motor's parts, then on to testing and reconnecting. Several chapters are devoted to motor protection, electronic maintenance and control maintenance. Discussion of mechanical drives and Code requirements as affecting motors rounds out the book.

REPORT ON THE STRENGTH OF WROUGHT STEELS AT ELEVATED TEMPERATURES, *by R F Miller and J J Heger of Carnegie-Illinois Steel Corp.* 112 *pp,* 8½x11, *paper.* $3. *Published by American Society for Testing Materials,* 1916 *Race St, Philadelphia* 3, *Pa.*

This 1950 Report gives a wealth of information and data on chemical and physical properties of wrought steels at elevated temperatures. It is issued under the auspices of the ASTM-ASME Joint Committee on Effects of Temperature on the Properties of Metals.

Largely a graphical presentation, data

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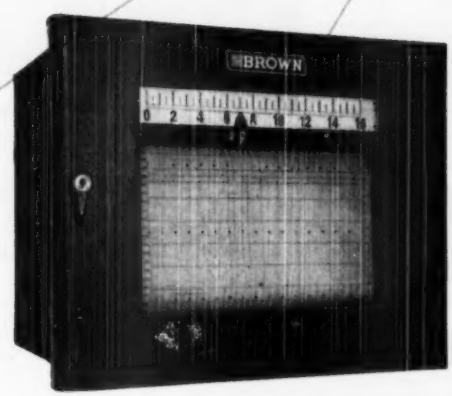

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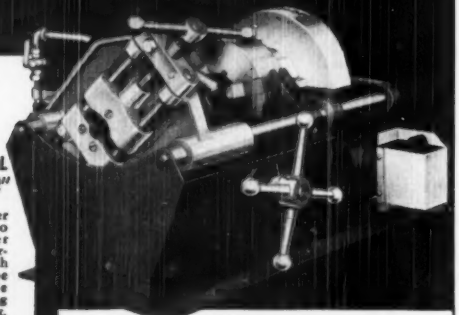

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POWER DRIVES...PIPE TOOLS...POWER PIPE MACHINES

for the Report were gathered from a large number of sources. All are included in the report. Data on tensile, creep and rupture properties are given for standard commercial grades of steel.

Plain carbon and alloy steels containing molybdenum and up to 3% chromium are covered in the first section. Second part covers ferritic and austenitic steels with more than 5% chromium, including many stainless steels. All of the many curves presented are easy to read.

This Report is of interest to all power-plant and equipment designers who use steels at elevated temperatures.

INDUSTRIAL HIGH-FREQUENCY ELECTRIC POWER, *by E. May, chief electrical engineer, Birlec Ltd.* 355 *pp*, 6x9, $5. *John Wiley & Sons Inc*, 440 *Fourth Ave, New 16, N.Y.*

This book stemmed from a series of lectures on Industrial High-Frequency Technology at the Birmingham Central Technical College in England. It is suited to the reader who is interested in applying high-frequency heating to industrial problems.

From basic-circuit theory to operating problems it provides a concise summation of facts in this field. There is a brief discussion of arc and spark oscillators in addition to a theoretical treatment plus practical applications of induction heating.

PROCEDURE HANDBOOK OF ARC-WELDING DESIGN AND PRACTICE, *9th edition*, 1200 *pp*, 1300 *photos and drawings*, 6x9, *simulated leather*. $2. *Lincoln Electric Co, Cleveland 1, Ohio.*

Completely reorganized and re-edited, this edition brings together the most recent and important welding developments. New design material makes the Handbook more helpful to designers of welded machines and structures. Latest procedures are given for welding all metals and alloys commonly welded with manual open arc and hidden arc welding, as well as automatic and semi-automatic hidden arc welding.

A new chapter on weldability gives a comprehensive survey of this subject. Facts revealed by research projects and recent studies are discussed. In addition the use of these facts in changing welding procedures on many metals is developed.

METALS AND ALLOYS (1950). *By technical staff of Metal Industry*. 214 *pp*, 8¾x5¾, *many tables, cloth*. $5. *Chemical Publishing Co, Inc*, 26 *Court St, Brooklyn 2, N.Y.*

This new edition covers some 4600 compositions. These are alloys generally classed as nonferrous, that is, they contain not more than 50% iron. It is, to a considerable extent, a list of alloys having definite names. Also included are proprietary alloys, whose names have been published, and many others having recognized composition. In addition a good many alloys not having specific names are covered under appropriate headings—Brasses, Bronzes, Copper-Nickel, etc.

Common uses for each alloy are given where known. Usual ranges of composition are often cited both for American and foreign alloys.

This book should be helpful to engineers

(*Continued on page* 177)

INTERNAL OR EXTERNAL BOILER WATER TREATMENT?

FIGHTIN' WORDS? Well, not exactly . . . but certainly a frequent cause of dispute in the front office as well as in the boiler room! Which method is the most practical . . . the most efficient . . . the most economical?

There is no general rule that can be followed. Present-day practice says "External treatment is often desirable—but internal treatment is always necessary." However, every case is different and must be considered on its own merit. That's why so many engineers depend on the Drew System of Water Treatment for the correct answer.

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No other relief device acts as quickly as the BS&B SAFETY HEAD. It consists of three principal parts . . . a pre-formed metal rupture disc and two specially designed holding flanges. Correct element resistant metals are used in fabrication of the rupture disc, which bursts when a predetermined pressure is reached. Instantly a fully unrestricted escape for gases and liquids takes place. And, as quickly the possible dangers of property damage, fires and injuries to personnel vanish.

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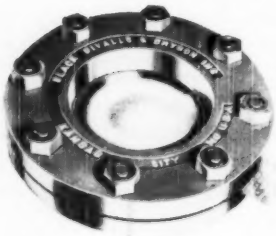
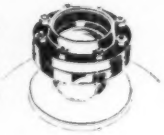
Do You need T-ASSEMBLY SAFETY HEADS?



The answer is YES . . . to every chemical plant using viscous materials under pressure provided the liquid contacts the metal rupture disc. Such plants should not be without this new positive protection relief device. Read the details on "How a T-ASSEMBLY SAFETY HEAD Works" on the opposite page. This newly designed T-Assemly unit is the combined art of the highest achievement of metallurgical and engineering skill.

Here Are Your Answers to Relief Valve Problems--Extra Protection for Expensive Equipment

This installation is used when it is not necessary to have a shut-off or when materials handled are not toxic or inflammable.

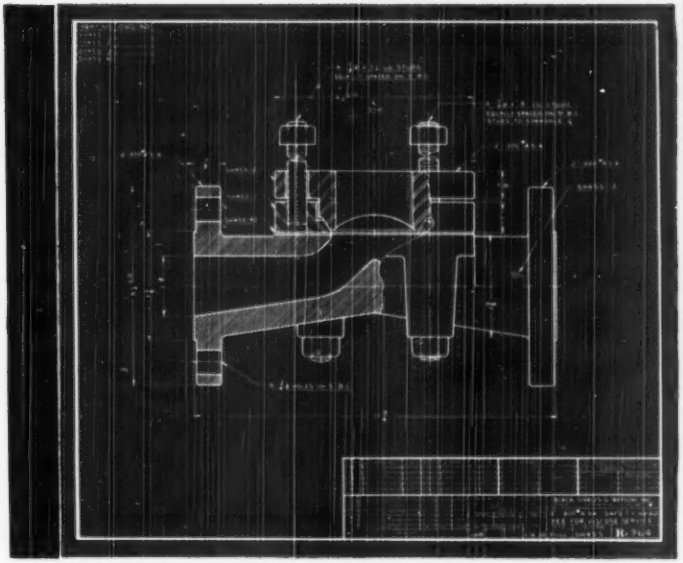


A SAFETY HEAD at the relief outlet will stop leakage until rupture disc pressure is attained. Not recommended where viscous or corrosive materials might contaminate internal parts of the valve. Investigate your valve design before using this type of installation.

A SAFETY HEAD under your relief valve isolates the valve from the vessel contents. This stops leakage through relief valve until SAFETY HEAD disc is burst by overpressure. An open bleed line or some type of telltale indicator must be installed in chamber between rupture disc and valve plug.

When the SAFETY HEAD is used as secondary relief device you are given positive protection when pressure rises to the predetermined bursting pressure of the rupture disc. The primary relief valve may fail to function due to corrosion, or pressure continues to rise due to inadequate relief area.

Solution: .... BS&B T-ASSEMBLY SAFETY HEADS



How the T-ASSEMBLY SAFETY HEAD Works

The shaded portions of the above diagram indicate a curved channel designed by BS&B through which the viscous material washes against the rupture disc. This material moves on through the passage if no undue pressure rise occurs. However, if the passage becomes blocked, such material will tend to solidify quickly, causing a dangerous pressure rise. In that case, the SAFETY HEAD rupture disc bursts and the pressure is given a fully unrestricted opening.

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BS&B SAFETY HEADS

in design work, men responsible for purchase of alloys, and others who must know what a material contains. Coverage is comprehensive, authoritative and conveniently arranged for easy reference. Power men who deal with alloys can get much from the tabulations.

STEEL-CASTINGS HANDBOOK. STELL FOUNDERS' SOCIETY OF AMERICA, 1950, 522 *pp*, 440 *illust*, 120 *tables, flexible leather*, $4. *Steel Founders' Society of America*, 920 *Midland Bldg, Cleveland* 15, *Ohio*.

Following a brief, interesting history of the steel-casting industry, this edition discusses classes and industrial uses of steel castings. Then there is a detailed treatment of steel-casting design.

Manufacturing processes are discussed for pattern equipment, melting practice, molding and coremaking, finishing operations, inspection and heat-treating facilities and operations. The latter subject is handled in a separate chapter containing details of heat-treatment principles, transformation diagrams, hardenability, liquid quenching and recommended practices for heat treatment of carbon and low-alloy steels.

Other specialized material includes chapters on mechanical properties, heat- and corrosion-resistant alloys, engineering properties, specifications, definitions, and recommendations to steel-casting purchasers. The volume is well indexed.

Designers of power-plant equipment should find much in this book to aid them in their work with castings.

LEXIQUE TECHNIQUE ANGLAIS-FRANCAIS (3rd *edition*, 1950). *By Guy Malgorn*. 332 *pp*, 5x8, *paper*, 1300 *fr* (110 *fr for shipping*). *Gauthier-Villars, Imprimeur-Editeur, Libraire du Bureau des Longitudes, de L'Ecole Polytechnique, Quai des Grandes-Augustins*, 55, *Paris*.

This handy book provides French equivalents for technical terms and words commonly used in engineering work. It covers the fields of power, internal-combustion engines, mining, metallurgy, aviation, electricity, communications and economics.

MOTOR OILS AND ENGINE LUBRICATION (1950). *By Carl W Georgi, Quaker State Oil Refining Corp*. 514 *pp*, 6x9, 150 *illust*, 109 *tables*. $8.50. *Reinhold Publishing Corp*, 330 *W 42nd Street, New York* 18, *N. Y*.

Here is a classified summary of existing knowledge on motor oils and their application in lubricating internal-combustion engines. The first part deals with the manufacture of motor oils, their chemical and physical properties, means and methods of testing and evaluating performance characteristics. Second part covers application of motor oils and relation of oils and lubrication to engine design, operation, maintenance, breakdowns and failures.

While the emphasis rests on automotive problems and practice, there is a chapter on diesel-engine lubrication and, of course, much of the information applies to all types of internal-combustion engines.

OUR OIL RESOURCES (2nd *edition*, 1950). *Edited by Leonard M Fanning*. 420 *pp*, 6x9,

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70 *illust, tables.* $5. *McGraw-Hill Book Co. 330 W 42nd Street, New York 18, N. Y.*

The possibility of an oil shortage is an ever-present bugaboo. Here is a collection of facts on most of the points that come up in connection with this question—oil and natural gas resources, conservation and public policy with respect to fuel reserves, technical development, synthetic fuels. The contributors are authorities in the petroleum field.

An interesting chapter reviews the oil-shortage "scares" of the past 35 years, pointing out that the oil needed has always been found.

Engineers concerned with petroleum fuels will find much of value and interest in this volume.

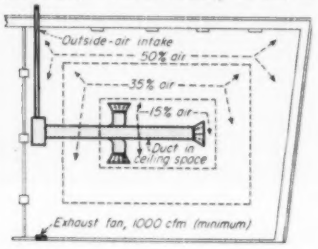
Plant Problems

(Continued from page 134)

Perforated Ceiling Works

PERFORATED CEILING gives best air distribution without drafts. My suggestions will serve as a guide in designing the system.

Allow at least 6 in. between perforated ceiling and underside of floor slab. This gives even air flow. Lay out duct so it's symmetrical, if possible. See sketch. Use a velocity of 600 to



800 fpm in duct. No return duct is needed if air-conditioning unit is in a conditioned room.

Direct more air to critical areas, such as walls containing windows. Less air is needed near inside walls and in center of room. Sketch shows zoning of ceiling based on symmetrical heat gains. This is probably incorrect for this particular case but illustrates the principle.

Install an exhaust fan to balance outside air brought in for ventilation. This will be about 10 cfm per person unless there is considerable contamination of inside air. *BL* should consider his air temperature again. I doubt if women seated at a bench can tolerate 58 to 62 F.

T E STEPAN *Vicksburg, Miss.*

Use Smaller Outlets

BL IS WISE to recognize in advance troubles he may have with drafts and dead spots. With his room temperature of 58 to 62 F the problem might get more troublesome, too. Largest

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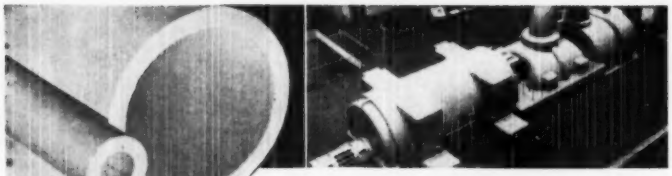

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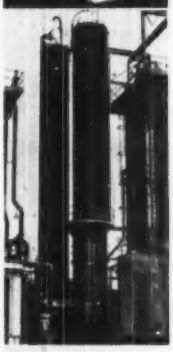

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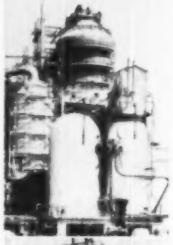

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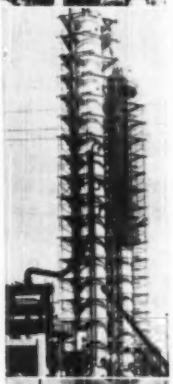

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single factor in prevention of drafts is proper selection of outlets or diffusers.

Proposed layout is based on minimum number of grilles, and I definitely recommend a reappraisal of it. General design and sizing of ducts seem OK. I suggest that two ducts be run in uniform sizes as plenum chambers with highest velocity in 1000-fpm range.

Space grilles selected uniformly on each side of branches. Distribute air over space near air conditioner shown in *BL's* sketch.

Eleven outlets, each handling 420 cfm won't do a good job here. They are too large and the quantities of air spilled into the room will pour out in "raw" streams. Uneven cooling results.

Select smaller outlets and increase number used. Larger percentage of room air will be entrained and more even cooling secured. Keep face velocity above 600 fpm to obtain good entrainment. With bays 15 ft square and 14 ft ceilings I recommend 24 grilles handling 200 cfm each. Fit each grille with an externally adjustable key-operated balancing shutter. Provide for adjustment of air flow in both horizontal and vertical directions.

A 15-ft throw at 600-fpm face velocity with center line of grille 2 ft below ceiling appears good. Use stock-size grille, 18x4 in. with 0.33 sq ft core area. Stock sizes are cheaper and smaller sizes have low cost.

A single-return opening away from working area is recommended. If *BL* finds drafts develop after system operates, an excellent plan would be to install a return-air plenum directly below supply duct. Use adjustable outlets on bottom face.

Perforated ceilings are too much of a problem in an industrial job. *BL* should not consider them if he wants low first cost for his job.

E F WEHLAGE *Fairport, N.Y.*

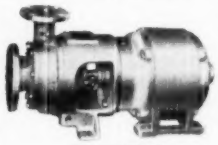
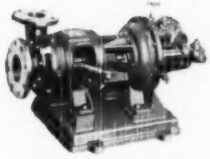
Hydro Power Co Plans 200,000-Kw Plant

Washington Water Power Co, Spokane, Wash., has made application to the Federal Power Commission to build a 200,000-kw hydroelectric plant. This plant would nearly double the company's power-generating capacity. It will be located at Cabinet Gorge on the Clark Fork River in Bonner County, Idaho, near the Montana state line.

Present plans call for installing three 50,000-kw units in a plant, with space for a fourth when it is needed. Power from the new plant will be taken into Spokane; there it will tie into the Northwest power pool comprising Federal and private power agencies.

Do you need a SPECIAL PUMP?

No matter how special your requirements, you may get exactly what you want, from ¼ to 40 hp, from this complete line of Ingersoll-Rand Motorpumps:

	HEAVY DUTY	STANDARD DUTY		MODIFICATIONS
 MOTORPUMPS	Single Stage 10 to 1800 gpm Heads to 240 ft. Two Stage 20 to 275 gpm Heads to 500 ft.	Single Stage 5 to 250 gpm Heads to 175 ft. Two Stage 5 to 55 gpm Heads to 300 ft. Four Stage 5 to 50 gpm Heads 300 to 600 ft.	Can be supplied with any desired type of direct-connected motor — single or polyphase, a-c or d-c; open, splash-proof, totally enclosed fan cooled, explosion proof or marine type.	Open impellers for handling liquids containing suspended material are available on most sizes of Motorpumps and Cradle-Mounted Pumps. To avoid leakage under unusual conditions, Cameron mechanical shaft seals, smothering type glands, or Merco - Nordstrom grease seals can be supplied. Casings and impellers can be built of special materials where required.
CRADLE-MOUNTED PUMPS	Single Stage 10 to 1800 gpm Heads to 240 ft. Two Stage 20 to 275 gpm Heads to 500 ft.	Single Stage 5 to 250 gpm Heads to 175 ft. Two Stage 5 to 55 gpm Heads to 300 ft.	Can be supplied with any type of motor (as above)—direct-coupled, gear driven, or V-belt driven. Also available with steam turbine or gasoline engine drive.	
CIRCULATING AND COOLANT PUMPS	Single Stage 5 to 150 gpm Heads to 125 ft.		Available in three types; 1) Immersion type (pump submerged in liquid) 2) External type, with side-wall mounting bracket 3) External type with bracket for horizontal mounting	
 TURBINE-DRIVEN PUMPS	Single Stage 5 to 1800 gpm Heads to 240 ft. Two Stage 5 to 275 gpm Heads to 500 ft. Four Stage 5 to 50 gpm Heads 300 to 600 ft.		Centrifugal pump element same as in Motorpumps — but direct-connected to a velocity stage, impulse type, steam turbine. Particularly applicable to refinery, process and gas plant service.	

These standard I-R Motorpumps are available for prompt delivery—from the factory, or from nearby District Office stocks. Even your so-called "special" requirements can be met quickly from our complete line of standard pump parts. Whatever your pump problem, your nearest I-R representative is qualified to give you expert assistance.

THE CAMERON MOTOR PUMP
A PRODUCT OF

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

472-9

COMPRESSORS · AIR TOOLS · ROCK DRILLS · TURBO BLOWERS · CONDENSERS · CENTRIFUGAL PUMPS · OIL AND GAS ENGINES

Steam

plus

CORAVOL

(The Original* AMINE PROCESS) ®

equals

Protection (FROM CORROSION)

Because CORAVOL Circulates to Control Corrosion

CORAVOL circulating throughout your steam system protects it from corrosive attack. **CORAVOL** saves costly pipe repairs and replacements—maintenance labor—hours and days of shutdown loss. **CORAVOL** cleans out clogging rust deposits, improving heat transfer, restoring original capacity of lines and efficiency of valves and traps.

CORAVOL, the original* amine process, has the flexibility that lets it conform to each individual need. The **CORAVOL** *you* will use is formulated to do the best protective job under your own plant conditions.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE which provides special formulas of chemical treatment for: boiler feed water . . . hot water supply . . . refrigerating brine . . . cooling and condenser water . . . rapid scale removal . . . coagulation . . . algae control . . . fuel oil supply . . . soot removal.

*The use of **CORAVOL** in steam systems is covered by U. S. Patent No. 2053024. The Western Chemical Co., owner of this patent, grants licenses under which volatile AMINES purchased from other sources may be used in steam systems upon payment of royalty to Western Chemical Co.

Chemical Water Treatment

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713 Washington Street
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Western Chemical Company,
713 Washington Street,
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Send me full information about CORAVOL.

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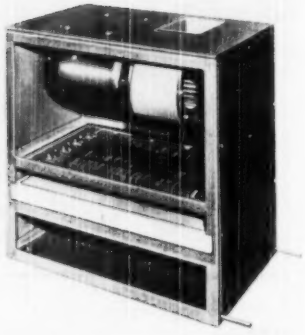
EQUIPMENT NEWS

(Continued from page 152)



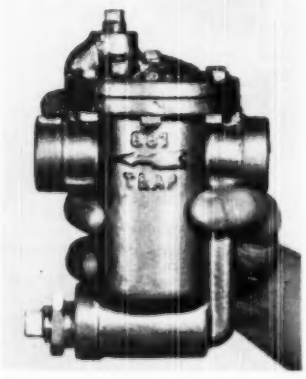
CRANE-CAB AIR CONDITIONER **P1138**

Model VHDF provides continuous ventilation, heating, dust filtering and fume protection for crane cabs and small confined spaces in industrial plants. Model VHD performs same functions except for fume removal. This model is intended for use where noxious fumes are not a problem but where dust filtering, ventilation or heating may be needed.

Fan sections can be rotated 90 deg to discharge air from top or either side. For cold weather, fresh air brought into units is heated by electric strip heaters, which automatically maintain temperature between 68 and 72 F in cab.

Either unit will operate on ac or dc. Model VHDF is 16 in. deep, 26 in. wide and 42 in. high. Model VHD is same depth and width but is only 26 in. high.

Dravo Corp, Air Conditioning and Combustion Dept, Dravo Bldg, Pittsburgh 22, Pa.



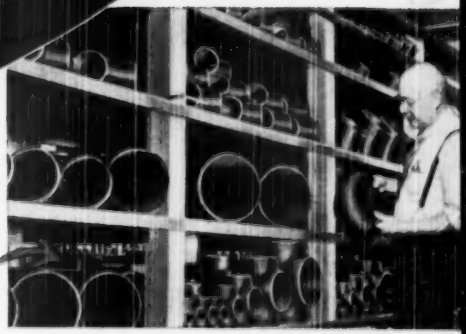
STEAM TRAP **P1135**

This small inverted-bucket steam trap has a brass strainer built into body. Known as No. 881 it is a side-inlet, side-outlet trap suitable for draining equipment producing relatively small amounts of con-

In all the world there's only one TUBE-TURN Welding Fitting as shown by this trade mark... the right mark for every need in welding fittings and flanges.

TUBE-TURN

TRADE MARK



More than ever, the services of your TUBE TURNS Distributor can be important to the smooth operation of your business.

TUBE TURNS, INC., LOUISVILLE 1, KENTUCKY DISTRIBUTORS IN ALL PRINCIPAL CITIES

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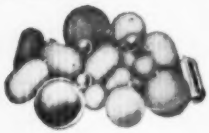
NICHOLSON TRAPS

UP STEAM FLOW 50%

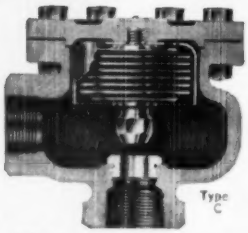
for Leading Processor

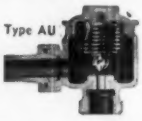
A striking increase in steam flow from 2000 to 3000 lbs. an hour is reported by a chemical maker who recently replaced a mechanical trap with Nicholsons. This cut cooking time from 105 to 55 min., a gratifying speed up of 48%. Also widely recommended for their effective venting of non-condensible gases in critical applications.

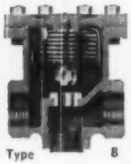
5 TYPES FOR EVERY PURPOSE—process, heat, power; size ¼" to 2"; press. to 225 lbs. **BULLETIN 450**



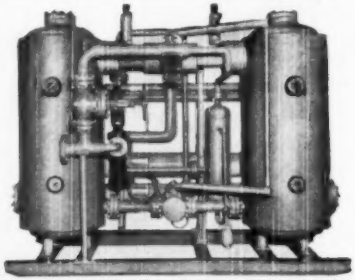
HIGH-PRESSURE FLOATS — Stainless, monel, plated steel. Welded. All sizes and shapes; for operating mechanisms and as vessels. 2-day delivery. **BULLETIN 348**







W. H. NICHOLSON & CO., 125 Oregon St., Wilkes-Barre, Pa.



Install the New Pritchard HYDRYER*...

...for Dependable Dehydration of Air and other Gases

Unexcelled for efficiency in drying air for instrument and process controls. Pritchard HYDRYERS are standard packaged units designed to reduce dew points of compressed air and other gases to minus (—) 40° F. Only service connections are required. Specially designed HYDRYER* units can be built to your requirements.

Write for FREE Bulletin No. 16.0.080 *Registered Trade Name

EQUIPMENT DIVISION
J.F. Pritchard & Co.
Dept. No. 99 908 Grand Ave., Kansas City 6, Mo.

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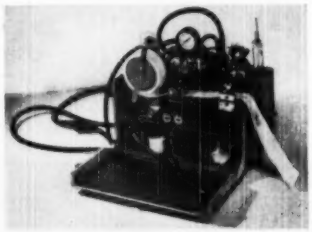
HOUSTON • ST. LOUIS • CHICAGO • PITTSBURGH • TULSA • NEW YORK
Other Representatives in Principal Cities from Coast to Coast.

For further data on items below, use reply cards on page 192a, identifying your request with letter P and number.

densate such as sterilizers, laundry and dry-cleaning presses, coffee urns, jacketed kettles, unit heaters, soap tanks, etc. This unit has greater capacity than No. 880.

Built-in strainer eliminates separate strainer, extra fittings and installation labor. Trap is available in ½ or ¾ in. pipe sizes, 250-psig operating pressure with capacities between 769 and 1060 lb per hr condensate.

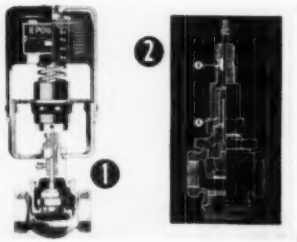
Armstrong Machine Works, Three Rivers, Mich.



SMOKE-RECORDER **P1129**

Based on the principle of filtering a known volume of flue gas to obtain a soot deposit on a filter new smoke-recorder uses the optical density of the deposit as a measure of smoke content in the entire flue-gas stream. The filter tape provided with timing marks is pulled through a fixture in a sampling gas stream drawn from the main stream by a vacuum pump. Separate switches control tape motion and vacuum-pump operation. Rolls geared to a synchronous motor insure a uniform speed of tape. Typical tape speeds are 2 to 4 in. per min.

E K Von Brand, 349 Ashford Ave, Dobbs Ferry, N. Y.



AIR-OPERATED VALVE **P1134**

Metaflow regulates flow of steam, water, oil or gases. It is diaphragm operated for pressure differentials below 75 psi, sizes ½ through 2 in. Available in standard valve (1), and packless valve body (2). It is suitable for control applications where pressure differential does not exceed 75 psi.

Housing is aluminum alloy; adjusting screw is brass with rustproof steel spring having 15-lb adjustment range. Bonnet assembly is stainless-steel stem in preformed,

You Save on 4 Counts with ENCO STREAMLINED BAFFLES

1 Better heat transfer

Enco's improved baffle design insures a uniform, high velocity gas flow over every square foot of heating surface.

2 Low draft loss

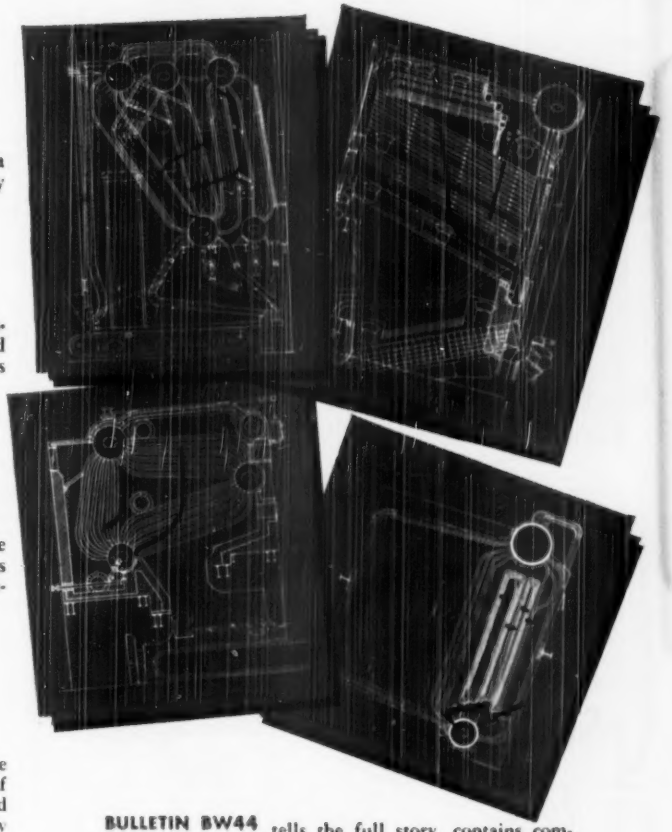
Smoothly curved baffles maintain a cross-flow of gases across the tube banks. Dead gas areas, bottlenecks and eddy currents are eliminated.

3 Less steam, less time for cleaning

Soot doesn't get a chance to accumulate in pockets. Soot blowers are used less often. Streamlined baffles lower maintenance costs.

4 Custom installation

Experienced Enco crews take charge of the installation, repairs and replacements of your individually designed streamlined baffles—do the job thoroughly and quickly with minimum downtime.



BULLETIN BW44 tells the full story, contains complete engineering data, explains how Enco Baffles provide maximum steam output with minimum fuel consumption. WRITE FOR YOUR FREE COPY TODAY!

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, NEW YORK

IN CANADA: F. J. RASKIN, LTD., 4220 IBERVILLE ST., MONTREAL 34 P.Q.

Discarding condensate because of OIL?

If you are throwing away valuable condensate rather than risk its return to the boiler because of oil contamination, filtration with Sorbo-Cel may be the answer to your problem.

Low in Cost

This specially processed diatomaceous silica powder provides a simple, economical method of removing emulsified oil from water and thereby obtaining an oil-free condensate for boiler feed or other use. Total cost ranges from only 1¢ to 3¢ per 1000 gallons of water filtered.

How it works

A small amount of Sorbo-Cel is simply mixed with the oil-contaminated water, which is then pumped through a pressure filter. Here the oil globules are removed by the specially treated Sorbo-Cel particles, and both are retained upon the filter screen. The filtered water alone passes through.

Does complete job

Sorbo-Cel does a complete job of oil removal. In addition, it removes other suspended matter such as rust, scale, clay and precipitates. And its action is so efficient that large volumes of water can be filtered in a relatively short time.

A bulletin that gives further facts about this low-cost way to remove oil from water is available on request. Just use the coupon below.

JM

Johns-Manville
SORBO-CEL

Johns-Manville
Box 290, New York 16, N. Y.
Send me free bulletin giving advantages of Sorbo-Cel filtration.

Name_____

Company_____

Address_____

City_____ State_____

Pow-11

For further data on items below, use reply cards on page 192a, identifying your request with letter P and number.

lubricated metallic packing. Bodies are bronze with screwed ends. Available direct- or reverse-acting or with 3-way valve.
Powers Regulator Co, 2771-A Greenview Ave, Chicago 14, Ill.

ADJUSTABLE THERMOSTAT P1111

Built-in adjustable heaters in thermostats for heating installations allow adjustments from 0.4 to 0.8 amp, enough to cover almost every installation. A simple turn of the adjusting screw on the back of thermostat eliminates the nuisance of carrying a variety of heating coils or plugs for proper heater setting in a thermostat.
Perfex Corp, 500 W Oklahoma Ave, Milwaukee 7, Wis.

UTILITY PUMP P1142

General-purpose utility pump quickly removes water from elevator pits, transformer and cable vaults, boiler rooms and other depressions in industrial plants. Unit, of corrosion-resistant bronze, can operate submerged. Pump may be operated automatically by a floatless liquid-level switch or manually by a cord switch.

Water can be drained down to within ⅛ in. of the pit's bottom by removing strainer and placing pump directly on strainer screw heads.
Kenco, Inc, Lorain, Ohio.

DRY COOLERS P1116

Heavy-gage steel casing, stiffened with structural angles, cast-aluminum alloy fans with V-belt drive, standard sections of round copper tubes with pressure-bonded aluminum or copper fins feature three additions to the company's *DriCooler* line. Two are portable units, the third is for medium-

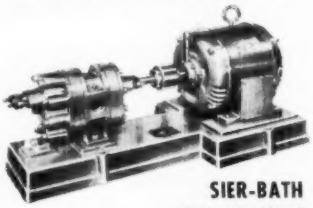
GEAREX ROTARY PUMPS move more—for less!

Rotating Element of GEAREX Pump

Photo shows the "heart" of a Gearex Pump. It provides **more displacement** per revolution because rotors do not transmit power—are designed to fulfill just **one** function: moving material. It means **less maintenance** because (1) rotors never touch metal (2) proper rotor clearance is accurately maintained by Sier-Bath **precision cut** timing gears.

ADDITIONAL ADVANTAGES

- Pulseless flow
- Vibrationless operation
- Low pressure on stuffing boxes
- Direct connected up to 1800 RPM
- Available in corrosion resistant alloys
- Horizontal or vertical construction



SIER-BATH GEAREX PUMP

Two general types: **INTERNAL BEARING TYPE** (above) for lubricating liquids, **EXTERNAL BEARING TYPE** for non-lubricating liquids. Capacities: 1-550 GPM. Discharge: 250 PSI for viscous liquids, 50 PSI for water. **SIER-BATH SCREW PUMPS** for higher pressures and capacities.

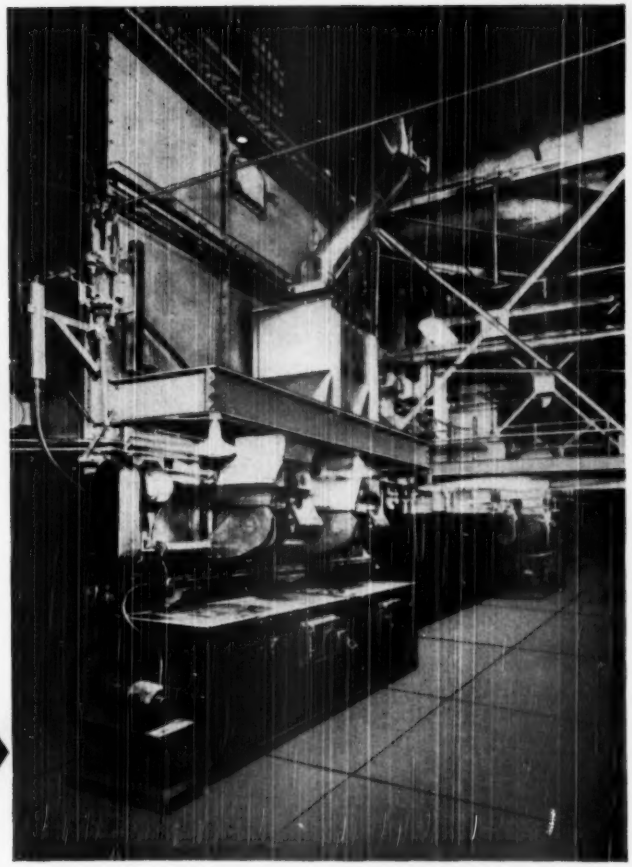
Write for Booklet

FOUNDED 1905 MEMBER A.G.M.A.

Sier-Bath GEAR and PUMP CO., Inc.

It's even coal distribution that gives peak combustion efficiency

AND AMERICAN PERFECT SPREAD STOKERS GIVE YOU BOTH



Two AE Perfect Spread Stokers recently installed by Marion Power Shovel Company. The boilers, each of 38,000 lbs. per capacity, are Wickes two-drum bent-tube type. Consulting Engineer, Frederick L. Smith. Send coupon for the complete story of this power plant.

SERVICE RECORDS prove that spreader stokers save money wherever installed. They burn almost any coal with remarkable efficiency, including the high moisture, high ash types.

And the AE Perfect Spread Stoker is the best investment you can make in a spreader. Its feeder assures continuous, accurate coal feed, even when coal is wet. Its spiral overthrow rotor *is unique and absolutely superior in distributing coal evenly over the entire grate.* Then, too, the AE engineered cinder reinjection and adjustable overfire air system play important parts in assuring maximum combustion efficiency.

Perfect Spread Stokers come with either continuous discharge, dumping or stationary grates. Capacities range from 8,000 to 500,000 lbs. of steam per hour. Mail coupon for Perfect Spread booklet and the Marion Power Shovel story.

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Car Shakers, Car Pullers

American Engineering Company
2400 Aramingo Ave., Philadelphia 25, Pa.

Gentlemen: We are certainly interested in saving fuel dollars. Send booklet on Perfect Spread Stokers and the story on Marion Power Shovel power plant.

Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....

Cars keep rolling off line when parts "fly" to the job

Increased production at a West Coast assembly line caused a parts shortage. Shipment in transit was located at St. Louis in late afternoon and Air Expressed to coast. Delivered 5 A.M. next morning. Speed like this keeps production rolling, lets you meet every delivery date. Shipping charge for 50-lb. carton: $24.56.

You get door-to-door service *included* in the low rate. This makes the world's fastest transportation method convenient and easy to use. Specify it regularly to keep customer service high—and high-cost inventories low.

Shipments go on all Scheduled Airline flights. Speeds up to 5 miles a minute—dependable service, experienced handling. For fastest shipping action, phone Air Express Division, Railway Express Agency. (Many low commodity rates in effect. Investigate.)

Air Express gives you all these advantages:

World's fastest transportation method.
Special door-to-door service at no extra cost.
One-carrier responsibility all the way.
1150 cities served direct by air; air-rail to 22,000 off-airline points.
Experienced Air Express has handled over 25 million shipments.

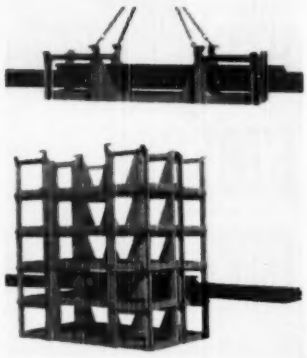
AIR EXPRESS
GETS THERE FIRST
Rates include pick-up and delivery door to door in all principal towns and cities
A service of
Railway Express Agency and the
SCHEDULED AIRLINES of the U.S.

For further data on items below, use reply cards on page 192a, identifying your request with letter P and number.

size duty such as cooling-engine jacket water, natural gas, lube oils, chemical solutions, ammonia or steam condensing.

Models *L* and *M*, the portable units, are both forced draft, have the same cooling capacity. Model *L* mounts fan and tube sections vertically. Model *M*, illustrated, has them mounted horizontally.

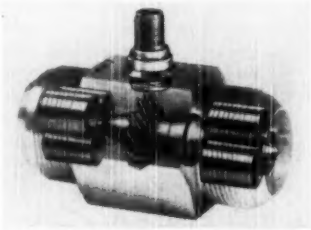
The Marley Co, Inc, Fairfax and Marley Rd, Kansas City 15, Kan.



BAR RACKS **P1105**

Portable, heavy-duty all-welded bar racks enable one-man-handling and storage of steel bundles. Racks are available to any capacity, permit placing bundles in them for storage in tiers.

Palmer-Shile Co, c/o A B Caldwell, Inc, 609 Stephenson Bldg, Detroit 2, Ill.



ELECTRONIC FLOWMETER P1128

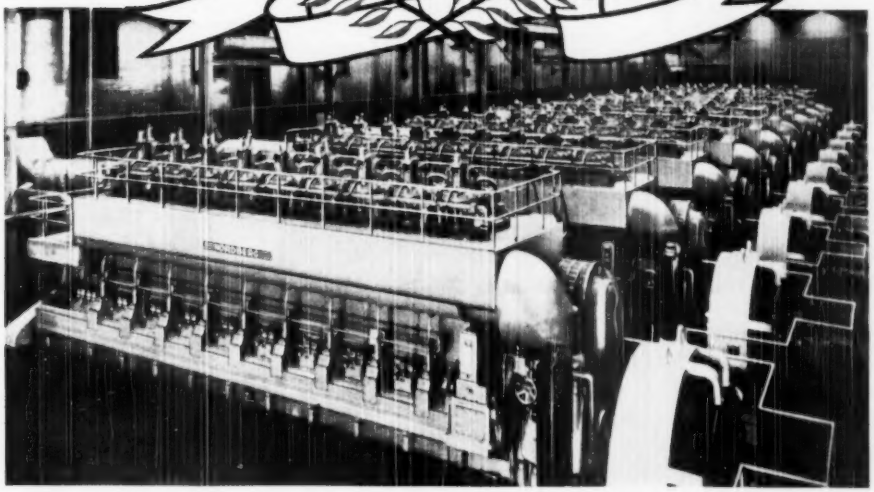
Accurate flow of any fluid especially high-capacity movement of corrosive liquids, gases, acids, liquid oxygen can be had with the electronic flowmeter. It incorporates a high-efficiency sensing rotor, which spins freely within a venturi. Standard sensing unit sizes run from ¾ to 3½ in. Although larger or smaller sizes can be furnished. Operating temperatures range from 4 deg absolute to 1000 F. Standard housing withstands up to 5000 psi.

Potter Aeronautical Co, 87 Academy St, Newark, N. J.

(*Continued on page* 190)

A Salute to
REYNOLDS METALS CO.

for notably efficient Diesel operation in one of the greatest installations of its kind

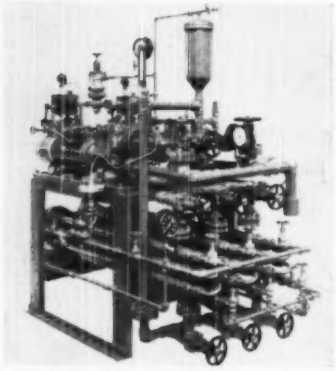


THE FAMED REYNOLDS METALS CO. plant at Jones Mills, Arkansas, ranks as a record-breaker on many counts. Among sources of power used at its aluminum reduction plant at Jones Mills is this great battery of eighteen 3600 HP Nordberg Gas Burning Diesel engines. This installation is notable not only for its size, but for its consistent efficiency record — a source of pride to Reynolds as well as to the engine builder.

Reynolds success with Nordberg Gas Burning Diesels merits the special recognition gladly given here by Cities Service—supplier of 15,000,000,000 cubic feet of natural gas used annually for all requirements in the Jones Mills plant of Reynolds Metals Co.

CITIES SERVICE

LOCKETT FUEL OIL PUMPING AND HEATING SETS *Custom Built*

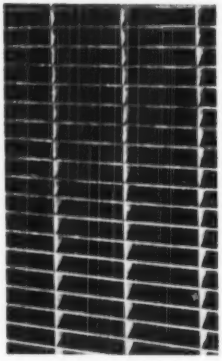


The compact, high-pressure unit illustrated consists of two Worthington Duplex Steam Pumps and three Griscom Russell Twin G-Fin Fuel Oil Heaters mounted on a single structural steel frame.

FOR almost a half century, Lockett has been supplying, to fit individual needs, efficient standard and custom-built Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Combinations of various types of pumps are available: Either two Turbine-driven Pumps; one Electric-driven and one Turbine-driven Rotary Pump; two Electric-driven Rotary Pumps; two Worthington Duplex Steam Pumps; or one Duplex Steam Pump and one Electric-driven Pump. Each pump is suitable for the full rated capacity of the unit; and one heater section is a spare. Lockett supplies everything, complete. *Inquiries are invited. Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.
Contracting Mechanical Engineers
NEW ORLEANS - HOUSTON - DALLAS - GALVESTON

HENDRICK ALUMINUM GRATING



SAVES WEIGHT — RESISTS CORROSION

Because it combines light weight, with ample strength, and high corrosion-resistance, Hendrick Mitco Aluminum Grating is especially desirable for many purposes.

It is being successfully used in such widely different applications as shipboard installations and in sewage disposal plants.

Its light weight minimizes handling and erection costs, and maintenance painting is not required. Write for full information on this recent Hendrick development.

SEE OUR CATALOG IN SWEET'S

HENDRICK
Manufacturing Company
46 DUNDAFF STREET, CARBONDALE, PENNA.
Sales Offices In Principal Cities

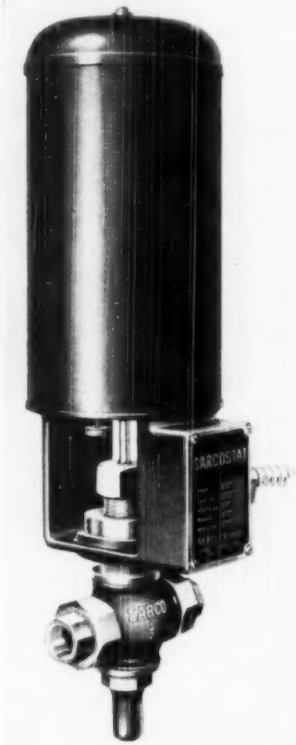
Perforated Metals
Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring,
"Shur-Site" Treads and
Armorgrids

For further data on items below, use reply cards on page 192a, identifying your request with letter P and number.

HYDRAULIC-MOTOR VALVE FOR OPEN-SHUT CONTROL P1133

Sarcostat is designed for automatic operation by thermostats, pressurestats, liquid-level or flow controls and permits open-and-shut control of gases and liquids. Valve is constructed to handle steam, water, oil, gas, air and other common substances. Electrical supply is 110-v ac, 60 cycles. Valve is normally closed, being opened by the valve operator actuated by hydraulic power. Direct thrust opens valves without use of gears, pilots or levers.

As a shutoff valve in inaccessible locations pushbutton operation can be used. Remote control by hand or thermostat, of steam or water branch mains for space heating systems, is another application. Opening action is gradual and closing is quick. Such action protects piping and prevents overheating.



Single-seated valves up to 1½ in. or double-seated units up to 4 in. at 125 psi are actuated by hydraulic power. When full stroke is used standard valves open in 60 sec and close in 10 sec. Valves are also available with adjustable stop.

Sarco Co, Dept 48, 350 Fifth Ave, New York 1, N. Y.

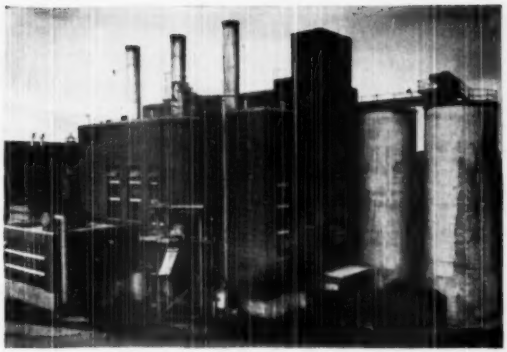
(*Continued on page 192*)

WE KNOW
COSTS CAN BE CUT

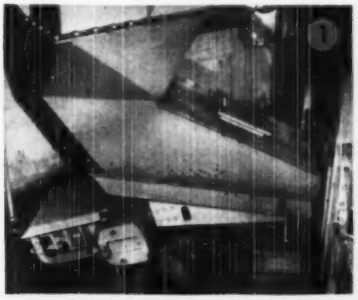
Started up almost a year ago, our NEW Steam Generating Plant (three 60,000 lb. per hr. boilers) is showing savings far exceeding expectations. Better thermal efficiency, generous savings in generating cost and reduced man-hours per year contribute to the over-all practicability of this new boiler house.

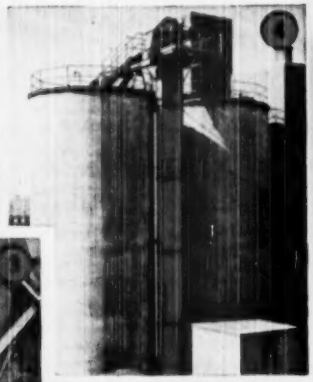
No glass house for us . . . dustless Coal Handling is provided by the use of Jeffrey equipment. Coal is speeded on its way from Track Hopper to Vibrating Feeder (No. 1) to Scraper Conveyor (No. 2) to FLEXTOOTH Crusher (No. 3) (or by-passed) to Bucket Elevator (No. 4) to Spiral Conveyors (No. 5) . . . thence to bunkers or silo storage. All Jeffrey including the Weigh Larries (No. 6).

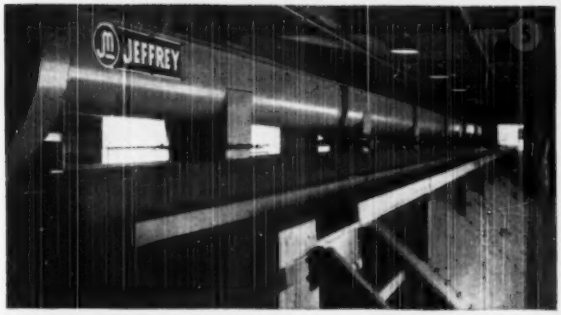
WE KNOW—SAVINGS CAN BE INCREASED—with Jeffrey Coal and Ashes handling machinery. Let us prove it.

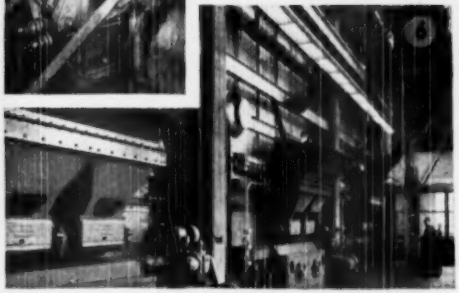


Above: Exterior view of the new plant—more modern and practicable than most.









THE JEFFREY MANUFACTURING COMPANY
932 North Fourth St., Columbus 16, Ohio
ESTABLISHED 1877

Complete Line of Material Handling, Processing and Mining Equipment

Jeffrey Mfg. Co., Ltd., Montreal, Canada
Jeffrey-Galion (Pty.) Ltd., Johannesburg, S.A.

BUILDING SERVICE REPUTATIONS

While Creating Savings

FOR PRIMARY EQUIPMENT MAKERS

WHS WINSMITH SPEED REDUCERS

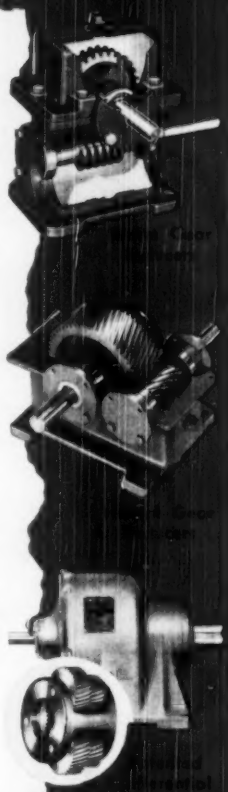
Management's penetrating interest in components of prime products goes deep . . . down to the last nut and bolt, as service reputation often hinges on individual parts, even those of outside manufacture. For the customer, failure of *any* part of the machine, regardless of cause or make, is a black mark against the *entire* product.

Vigilantly alert to this, the design engineer, the production manager, the purchasing agent, yes, even the sales manager—all concerned with the performance and marketability of primary equipment—are especially discerning in the selection of power transmission components.

Here you have one of the principal reasons that Winsmith Speed Reducers are so frequently selected . . . a preference based on enduring performance, the vital asset that means protection of a prime product's service reputation.

But you pay no premium for this protection. Actually, you save! For within the power range of fractional to 85 H.P., Winsmith has fully standardized on the widest selection of speed reducers in the industry . . . to serve you speedily and most economically.

Match *your* product's high reputation with components fabricated with the same care, backed by the same high reputation, that no link in your service chain may be weak. Winsmith power transmission engineers welcome the opportunity to consult. Write.



MEMBER OF AGMA

WINFIELD H. SMITH CORP.
128 EATON ST.
SPRINGVILLE (Erie County), N. Y.

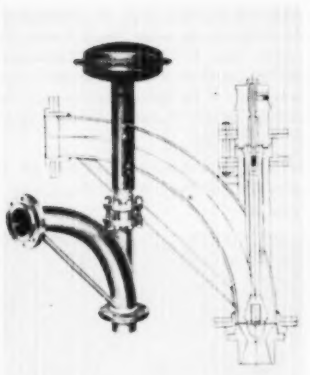
FREE Catalog Handbook No. 148 with complete engineering data. Write.

For further data on items below, use reply cards on page 192a, identifying your request with letter P and number.

SEALING COMPOUND **P1103**

Putty-like sealing material, *Cauxeal*, always stays plastic, never gets hard. It requires no preparation, adopts itself readily to contours, expands and contracts with movement.

X-Pando Corp, 43-15 36th St, Long Island City 1, N. Y.

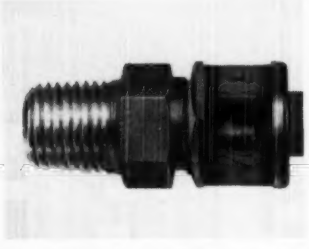


LONG-SWEEP ANGLE VALVE P1130

Designed to produce minimum turbulence during flow through valve these units are suited for slurry-control where solids may plug valve. Body is long-radius bend and can be fabricated of any material that can be bent and welded. Sizes range from 2 to 6 in.

Valve plug is streamlined and seat is designed as a section of a venturi throat. Plug lift is one-half nominal valve size. Standard spring range is 3 to 15 psi but higher ranges can be provided for higher working pressures. Valve can be used for control of process fluids of many types.

Hammel-Dahl Co, 243 Richmond St, Providence 3, R. I.



INSTRUMENT FITTINGS **P1131**

Swagelok fittings for instruments provide vacuum-tight seal to prevent leaks. Two ferrules and a threaded chuck clinch tubing wall tightly. Fittings will hold heavy- or thin-wall tubing. They are made for use with aluminum, brass, copper, steel, stainless steel or plastic tubing. Tube

(*Continued on page* 200)

PLANT EQUIPMENT NEWS

Reader Service Page for New Products and Literature

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

AIR CONDITIONING, HEATING REFRIGERATION AND VENTILATION

A6 **FAN ROOF VENTILATOR** — 4-page folder No. 341 describes the Airlift, a centrifugal fan roof ventilator for efficient duct exhaust against static pressure. Operates at very low noise levels. Table of capacities is given. Swartout Co, 18511 Euclid Ave, Cleveland 12, Ohio.

A7 **BACKWARDLY INCLINED FANS** —32-page booklet No. DS-348B contains construction features, characteristics, selection data, performance tables, etc, of Trane backwardly inclined fans. Photographs and diagrams are also included. Trane Co, La Crosse, Wis.

BOILERS AND AUXILIARIES

B17 **SPREADER STOKERS**—4-page publication No. 55 features Chicago Automatic unit drive spreader stokers. Cross-section view shows and lists operating features. A typical installation view is also given. Standard Stoker Co, 370 Lexington Ave, New York 17, N. Y.

B18 **INTEGRAL-FURNACE BOILER** —12-page brochure No. G-72 describes a compact, ready-to-use B&W integral-furnace boiler, Type FM, completely shop-assembled for unit shipment. Capacities, dimensions, and shipping weights of standard sizes are included. Babcock & Wilcox Co, 85 Liberty St, New York 6, N. Y.

B19 **POSITIVE DISPLACEMENT BLOWER**—16-page booklet presents informative data on the Standardaire axial flow positive displacement blower. Complete details are given on research and development, design, operating features, advantages and specifications. Standard Stoker Co, 370 Lexington Ave, New York 17, N. Y.

CONTROLS, MECHANICAL

E3 **SMOKE INDICATORS** — 8-page bulletin No. CM506 discusses how Fireye detects, indicates and records smoke conditions. Specifications and dimensions are given for smoke indicators, Sets FE-1 and FE-2, and smoke recorders, Series 55. Combustion Control Corp, 77 Broadway, Cambridge 42, Mass.

E4 **LIQUID LEVEL GAGES**—4-page publication No. 152 tells about company's complete line of liquid level gages, valves and specialties. General information and features of standard gage types are listed. Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass.

E5 **STEAM PUMP SPEED GOVERNOR** — 8-page bulletin and instruction sheet No. 603 describes the operation and applications of a speed governor and control valve that limits the speed of reciprocating steam pumps to a set valve. Mason-Neilan Regulator Co, 1190 Adams St, Boston 24, Mass.

E6 **AIR LOCKS**—Form No. S-31 features the company's air locks and trip master controls for holding regulating and control valves in position during failure of air supply. Operating principle, materials of construction and applications are listed. Swartout Co, 18511 Euclid Ave, Cleveland 12, Ohio.

E7 **INDUSTRIAL TEMPERATURE CONTROL** — 24-page manual No. 101, entitled "The Design and Process Engineers Guide to Industrial Tempera-

HOW TO ORDER ADDITIONAL DATA

Be sure to fill out, completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

When you have filled out completely one space for each item of information you want, detach along the scored lines and drop the cards in the mail.

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ture Measurement and Control," defines the different types of control systems and distinguishes between them so that the engineer can logically select the particular type most appropriate to his situation. Partlow Corp, New Hartford, N. Y.

E8 PRESSURE AND TEMPERATURE REGULATORS — 32-page booklet contains useful information about pilot-operated pressure and temperature regulators. Case example problems are cited to help users select correct types and sizes. Photos, charts and tables are included. Spence Engrg Co, Walden, N. Y.

ELECTRICAL EQUIPMENT

F27 WEATHER-PROOFED SWITCHGEAR — 8-page bulletin No. 18B-6143A describes construction features of Allis-Chalmers outdoor metal-clad switchgear that mean all-weather protection, operating convenience and safety to personnel and equipment. Also contains a table of ratings and dimensions, diagrams of standard assemblies, etc. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

F28 DIESEL ELECTRIC SETS—12-page booklet No. 30007 presents low cost electricity through the use of Caterpillar diesel electric sets for on-the-job power anywhere. Of 2 types, self-regulated and externally-regulated, both sets are designed to offer users maximum simplicity. Caterpillar Tractor Co, Peoria 8, Ill.

F29 SANITARY MOTOR — 8-page folder No. F-1607 sets forth the innumerable features of a sanitary motor. It emphasizes the difference between ordinary motors of the open type with the total enclosure of the sanitary design. Typical installations are illustrated. U. S. Electrical Motors Inc, 200 E Slauson Ave, Los Angeles 54, Calif.

F30 DRY TYPE TRANSFORMERS —12-page bulletin No. 126 describes and illustrates the company's complete line of dry type transformers, including open coil and completely enclosed types, unit substations and core and coil units. Sizes range from 0.1 to 2000 kva. R E Uptegraff Mfg Co, Scottdale, Pa.

F31 ELECTRICAL DISTRIBUTION —60-page catalog No. 25 discusses a modern, all-purpose trolley busway system of electrical distribution that provides outlets for power or light anywhere and everywhere along its entire length, always ready for use. Contents contain features and advantages, range and scope, general specifications, installation data, etc. Feedrail Corp, 135 Barclay St, New York 7, N. Y.

F32 POWER FACTOR CORRECTION—4-page leaflet No. 15B-7465 sets forth examples illustrating basic considerations in the improvement of system power factor. Reasons why synchronous motors and condensers improve the power factor are graphically presented. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

HEAT EXCHANGERS

★ **STEAM CONDENSERS** — 8-page bulletin No. 4101 describes a patented self-cleaning reverse-flow condenser for power plant service. Such a reversing arrangement virtually eliminates "cleaning down time" and, in the case of divided water box condensers, makes unnecessary operation at partial load. C H Wheeler Mfg Co, 19th St & Lehigh Ave, Philadelphia 32, Pa. (*Write direct to manufacturer on company stationery giving name and title.)

G3 DRY COOLING EQUIPMENT—8-page booklet No. DC-50 discusses 3 new models of the company's Dri-Coolers. Two are small portable units, while the other model is designed to fill the need for a medium size unit. Although primary use is for cooling engine jacket water, they can also be used for cooling natural gas, lube oils, ammonia or steam condensing, etc. Marley Co, Fairfax & Marley Rds, Kansas City 15, Kansas.

MAINTENANCE AND SAFETY EQUIPMENT

K8 FIRE EXTINGUISHMENT — 4-page leaflet, entitled "Fundamentals of Fire Extinguishment," discusses what fire is, classes of fire and proper methods of extinguishment. Ansul Chemical Co, Marinette, Wis.

K9 ELEVATOR SAFETY CLAMP—8-page bulletin describes and gives several application photos of an elevator safety device, installed on elevator ropes to take the load if they fail at their sockets. Safety Devices Inc, Third National Bank & Trust Bldg, Springfield 3, Mass.

K10 INSULATION BREAKDOWN TESTERS — 4-page folder No. 5A features 15 models of Hypot high-potential insulation breakdown testers which can be used on diesel-electric locomotive, motors, generators, and insulated power lines; and dielectric strength testing of materials. Associated Research Inc, 3770 W Belmont Ave, Chicago 18, Ill.

K11 METALLIZING—4-page bulletin tells about the metallising process for making mechanical repairs and protecting surfaces against corrosion and contamination. Profusely illustrated with pictures. Metalweld Inc, 26th & Hunting Park Ave, Philadelphia 29, Pa.

K12 TUBE EXPANDERS — 4-page brochure No. 80 presents Henderer Type FC tube expanders with frictionless collar for condensers and heat exchangers. Sizes and prices are listed. A L Henderer's Sons, Maryland Ave, Wilmington, Dela.

K13 PIPE CUTTER—4-page flier covers the Beaver 101-PD pipe cutter designed for use with any make of pipe cutting power drive. Also described is the Beaver No. 77 threader, a quick-opening, adjustable, ⅛—2 in. pipe threader designed for use with modern electric power drives. Beaver Pipe Tools Inc, Warren, Ohio.

MAINTENANCE MATERIALS

L24 CORROSION PROOF CEMENTS —Bulletin No. 5-1 describes company's complete line of resin, sulfur, silicate and asphaltic cements. Information on each cement is compiled in handy chart form for easy selection of the correct cement for a specific application. Atlas Mineral Products Co, 43 Walnut St, Mertztown, Pa.

L25 CHEMICAL CLEANING—4-page folder explains the Sumco chemical cleaning service for steam boilers, condensers, feedwater heaters, fuel oil heaters, air conditioning equipment, diesel engines, etc. Also presents facts about advanced practices in chemical cleaning. Sumco Products Inc, 144 Centre St, Brooklyn 31, N. Y.

L27 PAINT COATINGS — Maintenance portfolio contains informative data on specialized paint coatings for resisting moisture, fire, mildew and chemicals. Maintenance problems of equipment and buildings are analyzed

(Continued on page 194)

FIRST CLASS
PERMIT No. 64
(Sec. 34.9, P.L. & R.)
NEW YORK, N.Y.

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NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

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330 West 42nd Street

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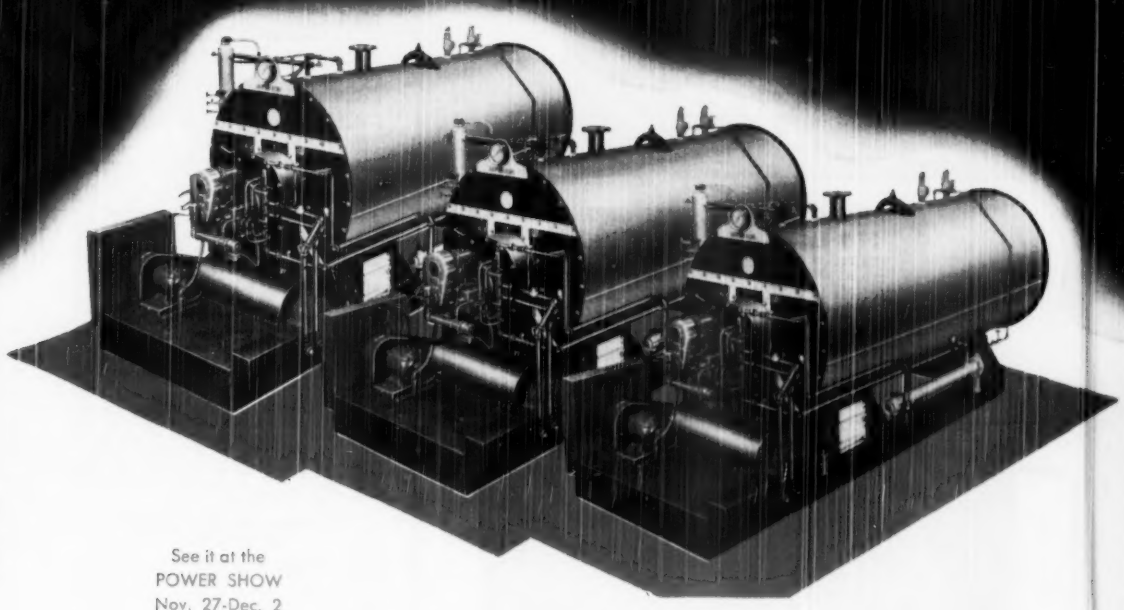
WHEN YOU'RE COUNTING

Superior STEAM GENERATORS



See it at the
POWER SHOW
Nov. 27-Dec. 2

Battery installations of Superior Steam Generators provide extreme flexibility to meet the most widely fluctuating steam demands. A hospital installation illustrates the point.

From early June through September, steam demand is limited to the needs of hot water and sterilization. Any one of the three units carries this load with ease . . . and at higher efficiency than could be obtained by minimum operation of a larger boiler.

When cold weather adds its heating load, a second Superior Steam Generator is fired. Only the most severe weather demands firing the third unit . . . which throughout the rest of the year provides stand-by equipment which is desirable in any operation.

By employing different combinations of the three, (7 in all) allowing each unit in turn to share the load; all enjoy longer life at maximum efficiency . . . and by using only the number dictated by the steam demand, maximum economy at every stage of steam demand is assured.

Let us show you how battery installation can serve you better in your new plant . . . or augment your present steam facilities.

Write today for Catalog 201

Superior Combustion Industries, inc.

Factory: Emmaus, Pa.
Executive Offices: Times Tower, Times Square, New York 18, N. Y.

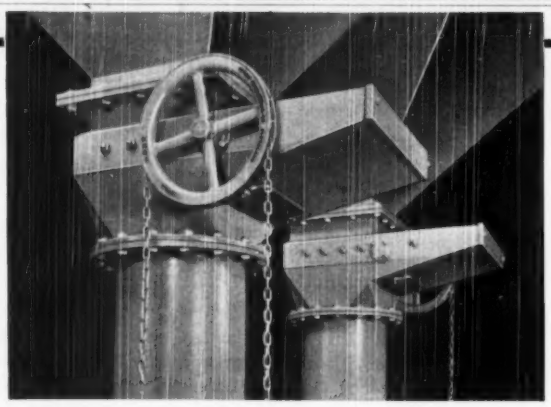
The World's Fastest TUBE BENDING SERVICE

BOILER TUBE CO. OF AMERICA

McKEES ROCKS, PA. (Pittsburgh District)

PITTSBURGH — CHICAGO

FRED S. RENAULD & CO. — LOS ANGELES



S-E-CO. COAL VALVES are equipped with operating chain of a size and shape to fit the hands of the operators. S-E-Co. Hand Chain was selected not for low cost but rather for a type which operators would find comfortable to grasp. This chain is but one of the features that make S-E-Co. Coal Valves superior.

Send inquiry to

STOCK EQUIPMENT COMPANY

715P Hanna Building ★ Cleveland 15, Ohio

and recommendations made for economical upkeep. Wilbur & Williams Co, Greenleaf & Leon Sts, Boston 15, Mass.

L28 **HYDRAULIC OILS** — 8-page booklet No. A-2186 stresses importance of using correct hydraulic oil to obtain higher production speeds, precise control, and longer production runs. Sun Oil Co, 1608 Walnut St, Philadelphia 3, Pa.

MECHANICAL TRANSMISSION

N13 **WORM GEAR DRIVES** — 80-page book No. 2324 illustrates, describes, and tabulates Link-Belt worm gear drives of 3 basic types, each available in 10 different sizes, for fractional or large hp, and in speed ratios of 3½ to 1 up to 8000 to 1. Also contains typical drive problems with their solutions. Link-Belt Co, 307 N Michigan Ave, Chicago 1, Ill.

N14 **MINIATURE SPEED CHANGERS** — 4-page folder No. 100 covers miniature fixed ratio speed changers, available in 3 different series: Series 5 is for ordinary gearing applications; Series 6 for precision gearing applications; and Series 7 for applications requiring zero backlash. Table shows all of the standard integral ratios. Metron Instrument Co, 432 Lincoln St, Denver 9, Colo.

N15 **NEOPRENE BELTING** — Catalog section, entitled "All Neoprene Belting for Light Conveying and Transmission Work," gives complete details on applications, and construction of Baldwin brown or white Superdrive belting. Also includes a table of technical specifications. Baldwin Belting Inc, 74-76 Murray St, New York 7, N. Y.

N16 **WORM GEAR REDUCER**—36-page catalog No. 130 contains hp rating tables which present the power transmission capacities of the various sizes of Cleveland worm gear reduction units. Dimensions and diagrams are given. Cleveland Worm & Gear Co, 3261 E 80th St, Cleveland 4, Ohio.

N17 **SPEED REDUCERS**—2 bulletins are offered. No. 2105 covers horizontal right angle speed reducers and No. 2110 features vertical right angle speed reducers. Both provide information on selection, service factors, dimensions, etc. Falk Corp, 3001 W Canal St, Milwaukee 8, Wis.

METERS AND INSTRUMENTS, MECHANICAL

T18 **FLOWMEETERS**—32-page data book No. 702 fully illustrates and explains flow measurement problems and their solution. Meter bodies, differential devices and reading instruments are fully described and a special section covers wide range and reverse flow. Numerous illustrations on fluid flow measurement are also included. Republic Flow Meters Co, 2240 Diversey Pkwy, Chicago 47, Ill.

T19 **DRAFT GAGES**—4-page folder No. 124 discusses Ellison Diafram type straight line draft gages. Features are described and illustrated. Gage and drilling dimensions are also given. Ellison Draft Gage Co, 214 W Kinzie St, Chicago 10, Ill.

PIPING, FITTINGS, VALVES AND SPECIALTIES

U27 **GAS LINE SCRUBBERS**—12-page catalog No. 501 furnishes the basic design and operation of the Aerotec gas scrubber in all the forms and applications developed to date. Dimensions and flange sizes are listed. Low pressure and high pressure selection charts with instructions are also included. Aerotec Corp, Greenwich, Conn.

U28 **NON-RETURN VALVES** — 8-page bulletin No. S-1 covers triple acting non-return valves. Features and function are fully explained. A general list of materials, diagrams, dimension tables and instructions are given. Golden-Anderson Valve Specialty Co, Keenan Bldg, Pittsburgh, Pa.

U29 **ASBESTOS-BONDED PIPE**—6-page folder No. AB-3250 tells how Armco asbestos-bonded pipe over-

It's New!...but so much more than just New

TO CONTROL and maintain processes at ideal flow, temperature, or pressure, the new 150# Hancock Bronze Flocontrol Valve is the most efficient and economical valve you can use.

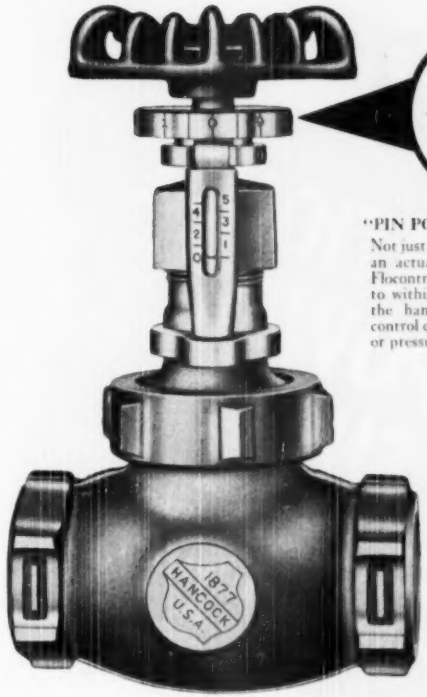
Though it is a fine, strong, leak-defying valve, *it is also a precision control instrument.* The Hancock Flocontrol has a sturdy micrometer dial and pointer securely attached to the valve bonnet. This device enables the operator to "set" the valve at the ideal opening—within a 1/100th turn of the handwheel. And this precise setting can be exactly and instantly duplicated the next day, week, or month.

The scientifically designed V-Port disc *compels proportional flow throughout the entire lift of the valve stem.* Straight-line flow is not dependent upon the short-wearing, fine threads of a needle valve. The Hancock Flocontrol Valve has long-wearing standard Acme threads.

The shut-off seating surface is entirely separate from the controlling V-Ports. Wire drawing and cutting action are minimized; a separate shut-off valve is not needed.

Seats and discs are "500 Brinell" stainless steel. Foreign matter or steam cutting cannot affect their mirror-like finish.

Hancock Flocontrol Valves reduce production costs. They eliminate guesswork in the control of flow, temperature, or pressure.



"PIN POINT CONTROL"
Not just a "catch phrase" but an actuality. The Hancock Flocontrol Valve can be "set" to within a 1/100th turn of the handwheel for precise control of flow, temperature, or pressure.

OTHER HANCOCK FLOCONTROL VALVES FOR HIGHER TEMPERATURES AND PRESSURES

BRONZE FLOCONTROL, 300# W.S.P., 550° F.
Globe & Angle—Screwed Ends—Sizes ½" thru 2"
STEEL FLOCONTROL, 600# W.S.P., 850° F.
Globe & Angle—Screwed & Socket Weld Ends
Outside Screw & Yoke—Sizes ¼" thru 2"
STEEL FLOCONTROL, 600# W.S.P., 800° F.
Globe & Angle—Flanged Ends
Outside Screw & Yoke—Sizes ½" thru 2"

CAST STEEL FLOCONTROL—Screwed Bonnet—300# W.S.P., 800° F.
Outside Screw & Yoke—Screwed & Flanged Ends—Sizes 2½" & 3"
CAST STEEL FLOCONTROL—Bolted Bonnet—300# and 600# W.S.P., 800° F.
Outside Screw & Yoke—Flanged Ends—Sizes 2½" thru 4"

Contact your nearest Hancock Distributor for complete information

MAXWELL MANNING M&M MOORE INC. TRADE MARK

HANCOCK *Valves*

1877 HANCOCK U.S.A.

A PRODUCT OF
MANNING, MAXWELL & MOORE, INC.
WATERTOWN 72, MASSACHUSETTS

Makers of 'Hancock' Valves, 'Ashcroft' Gauges, 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electrical Instruments. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load-Lifter' Hoists and other lifting specialties.

"TIME WELL SPENT"—you'll say

New money-saving ideas were never more important than NOW to combat high costs and keener competition. That's why you and your associates can't afford to miss this foremost presentation of power and allied equipment.

Plan NOW to attend the . . .

Auspices A.S.M.E. in conjunction with Annual Meeting

NEW IDEAS! Over 300 manufacturers showing, demonstrating, and explaining latest techniques, equipment, and materials for more efficient power production and utilization, materials handling, and plant services . . . newest and best ways to expand and modernize for greater operating and maintenance economy.

ASK THE EXPERTS! An unequalled opportunity to get first-hand technical advice on adapting new cost-saving equipment, supplies, and methods to your present operations and future plans. In no other way can you get so much help on your power problems in so little time.

Make it a Must for New Ideas—Bring Your Associates

Management International Exposition Co.

comes the problems of structural failure and corrosion. Describes how asbestos-bonded drainage structures are made and summarizes corrosion tests that demonstrate durability of the material. Armco Drainage & Metal Products Inc, Middletown, Ohio.

U30 **HYDRAULIC VALVES** — 52-page catalog No. 202 illustrates and describes nearly every type of 4-way hydraulic valves offered in the industry. Description of each model valve includes working drawings, specifications, cut-away views, and operational diagrams of piston designs. Rivett Lathe & Grinder Inc, Brighton 35, Boston, Mass.

U31 **FLEXIBLE METAL HOSE** — Catalog No. 500 contains informative data on flexible metal hose. Section 1 includes interlocking high pressure hose, air jacketed hose for diesel exhausts, and conveyor hose for ventilating and exhausting. Section 2 refers to seamless high pressure and diesel exhaust hose. Section 3 is concerned with metal lined gasoline and synthetic rubber gasoline hose. Atlantic Metal Hose Co, 123 W 64 St, New York 23, N. Y.

U32 **SOLENOID OPERATED VALVES**—72-page book No. 23 covers Asco solenoid operated valves in 10 sections as follows: General information, selection tables and terms; flow charts for water, air, gases and steam; safety shut-off and manually reset valves; packless solenoid valves—full pipe area; packed solenoid valves—full pipe area; packless solenoid valves—small sizes; 3-way solenoid valves; 2- and 3-way pilot controlled solenoid valves; 4-way solenoid valves; filters and strainers. Automatic Switch Co, 279-B Lakeside Ave, Orange, N. J.

PUMPS

W14 **MOTOR-DRIVEN PUMP** — Bulletin No. 52B61401 explains design and construction features of the Electrifugal pump, a close-coupled pump and motor, which has a single shaft mounted in an exclusive unit-cast frame to assure perfect and permanent alignment. This pump is available in ratings from 10—500 gpm at heads to 220 ft. Motors are rated from $\frac{3}{4}$-10 hp. Allis-Chalmers Mfg Co, 952 S 70th St, Milwaukee, Wis.

W15 **HIGH PRESSURE PUMPS** — Data sheet No. 64-B describes Aldrich 5-in. stroke multiplex direct flow pumps. This 6-page bulletin covers design advantages, construction, specifications and drive requirements. Also includes selection chart, dimension drawings, plunger, pressure and capacity data on both the 5 and 7 plunger units. Aldrich Pump Co, Allentown, Pa.

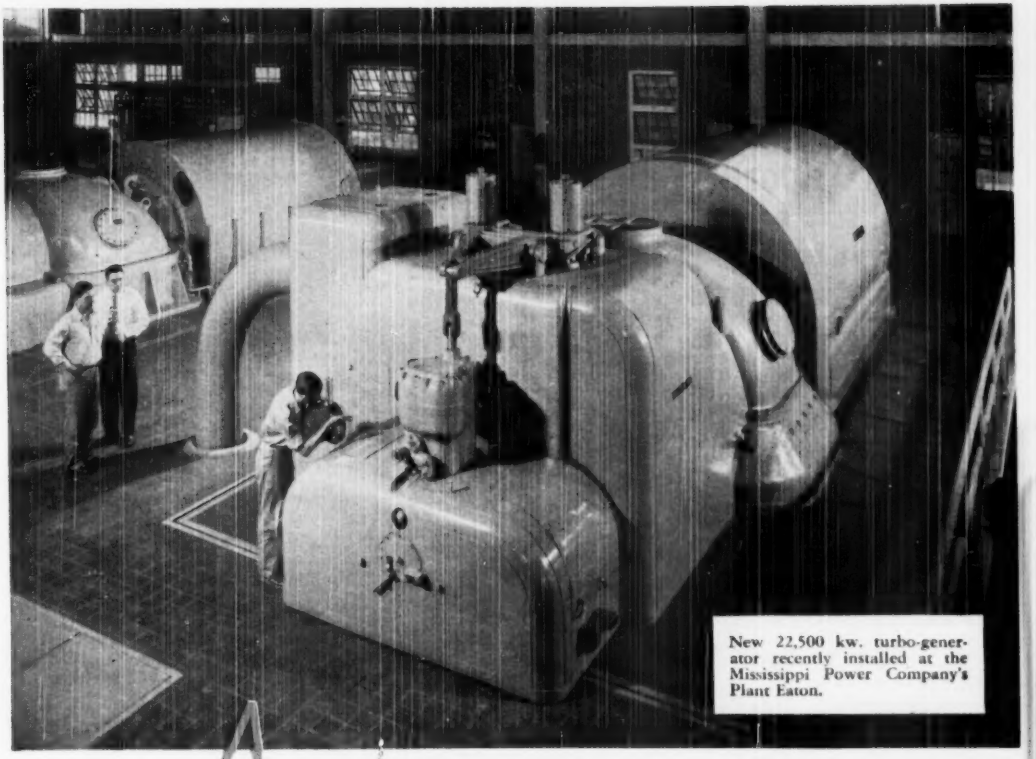
W16 **FLUID PRESSURE BOOSTERS** —12-page catalog No. B-200 tells how this company's line of low cost production-line fluid pressure boosters can be employed to save space and weight, cut costs and increase efficiency in clamping, punching, shearing, stamping, crimping, welding, pressing and similar applications accomplished by compressed air or hydraulic power. Miller Motor Co, 4027 N Kedzie Ave, Chicago 18, Ill.

WATER TREATMENT

X11 **FEEDWATER TREATMENT**—6-page bulletin No. W-212B7 presents the Hot-Z system for treating boiler feedwater. Discusses development, filtration, backwash water, direct contact vent condenser, complementary recirculation, backwashing, proportionate sludge removal and application of the Hot-Z. Worthington Pump & Machy Corp, Harrison, N. J.

X12 **WATER SOFTENERS**—Bulletin No. V-11 illustrates and describes the firm's various types of fully automatic and semi-automatically operated Inversand zeolite water softeners. Also features the new poppet type multiport valve which is built in many sizes and for both sodium cycle and hydrogen cycle ion exchange work. Hungerford & Terry Inc, Clayton, N. J.

X13 **CORROSION CONTROL** — Broadside, entitled "Corrosion of Brass Pipe and Copper Tubing," tells about the corrosion effect of water on



New 22,500 kw. turbo-generator recently installed at the Mississippi Power Company's Plant Eaton.

Another progressive utility selects Gulfcrest Oil for new turbine unit

Another new turbine gets the safe, sure, long lasting protection of Gulfcrest, now more than ever the world's finest turbine oil!

Another case, too, where outstanding performance in other turbines operated by the same utility led to the selection of Gulfcrest Oil for the new units.

Extra refining makes the difference! After the carefully selected crude oil used in Gulfcrest goes through the major refining methods, it is then supperrefined by the Alchlor Process.

As much as 15 per cent of the oil is discarded by the Alchlor Process—this 15 per cent contains the hydrocarbons most apt to oxidize and form sludge, emulsifiers, and harmful acids.

That's why Gulfcrest is incomparably pure—why it gives outstanding performance, and lasts indefinitely. Call in a Gulf Lubrication Engineer today for complete information on this superior oil. Write, wire or phone your nearest Gulf office.

Gulf Oil Corporation · Gulf Refining Company

GULF BUILDING, PITTSBURGH, PA.

Sales Offices - Warehouses
Located in principal cities and towns throughout Gulf's marketing territory

GULF INDUSTRIAL LUBRICATION

For STRENGTH specify

TRI-LOK

RECTANGULAR

OPEN STEEL FLOORING

The locked-in strength of Tri-Lok enables it to stand up under heavy loads—even on long spans. Get maximum strength, air and light with minimum weight.

Tri-Lok is also available in Diagonal, or Super-Safety U-type Flooring, and in Stair Treads of all types. Write for Bulletin KM 1140.

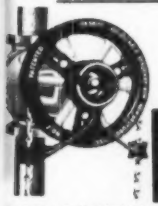
The Tri-Lok Company is also equipped to furnish *riveted* and Tri-Forge *welded* open steel flooring. Tri-Lok can be furnished in a variety of metals, including aluminum alloy, stainless steel, etc.

DRAVO CORPORATION

National Distributor for the
Tri-Lok Company
Dravo Bldg., Pittsburgh 22, Pa.
Sales Representatives in
Principal Cities

DRAVO

NOW! All Overhead Valves are Instantly Accessible



with the

LOW-COST

Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

● Range of 10 adjustable sizes takes care of all valve makes and types; fits valve wheel diameters from 2 to 30 inches.

● Overhead valves—no matter how high up, or in whatever hard-to-get-at location—are instantly accessible from the floor! Operation of valves is quick, easy, positive and safe with the BABBITT Adjustable Sprocket Rim with Chain Guide. No more climbing on bench, machine, boiler or treacherous stepladder; no time-wasting.

● The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

● Write today for Catalog Bulletin P, surprisingly low prices, and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Mass.

the different kinds of brass pipe, and on copper tubing. Also explains the procedure that can be used to minimize the damage done by such corrosion. Water Service Labs, 423 W 126th St, New York 27, N. Y.

OTHER EQUIPMENT

Z25 **MATERIALS HANDLING**—24-page catalog No. 77 covers the company's line of corrugated steel boxes, skids, pallets and combination units. Illustrations and complete descriptions are given. Union Metal Mfg Co, Canton 5, Ohio.

Z26 **HEAT INSULATING BLOCK**—4-page folder discusses Kaylo heat insulating block for temperatures up to 1200 F. Typical applications and physical characteristics are listed. Kaylo Div, Owens-Illinois Glass Co, Toledo 1, Ohio.

Z27 **ELECTRODES**—24-page catalog No. EN-85 presents the company's complete line of pH electrodes and assemblies for both industrial and laboratory applications. Glass electrodes for industrial use are shown in detail, whether for use in plastic, Pyrex or iron assemblies. Glass electrodes for laboratory use are illustrated with their appropriate measuring instruments. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

Z28 **OPEN STEEL GRATING**—24-page booklet, entitled, "Klemp Open Steel Grating," explains and illustrates different types of diamond riveted open steel grating and welded electro-forged open steel flooring and stair treads, as well as open steel bridge decking, aluminum bridge decking and aluminum grating. Klemp Co, 6601 S Melvina Ave, Chicago 38, Ill.

Z29 **PIPE INSULATION**—4-page folder gives informative data on Kaylo pipe insulation for temperatures from 200-1200 F. Tables show standard sizes and thicknesses, recommended thickness, physical characteristics, and insulation efficiencies and heat loss. Kaylo Div, Owens-Illinois Glass Co, Toledo 1, Ohio.

Z30 **METER ENGINEERING**—16-page booklet discusses in detail the firm's meter engineering services. Subjects covered include meter engineering and development, service buildings, meter records, special meter problems, special test equipment, service costs and meter retirements. Commonwealth Services Inc, 20 Pine St, New York 5, N. Y.

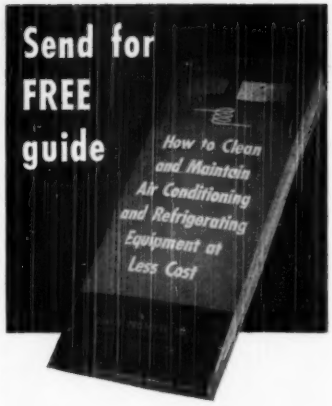
Atomic Weapons Under Discussion

The Effects of Atomic Weapons, the Government's recently issued guide book for the preparation of safe defense measures against atomic attack, was the subject of an evening round-table discussion by prominent authorities on October 25 at the Park Sheraton Hotel, New York City.

The forum, part of the annual joint 3-day conference of the AIEE and the Institute of Radio Engineers, heard, among others, Brig Gen James P Cooney, Prof H L Bowman and Dr Herbert Scoville.

Basic data in this book are being analyzed for POWER readers in 15 pages—two pages in October (pp 80, 81), six in November (pp 74-79), and seven in January.

United States Rubber Co recently announced that more synthetic than natural rubber will be used from Oct 1950 through the year 1951. Synthetic will account for 54% of the country's total consumption in the last four months of 1950 and considerably more in 1951. For the first eight months of 1950 it was 40%.



HOW are other plant engineers handling today's problem of maintaining efficiency of air conditioning equipment? What short-cuts are proving successful in conserving water—saving operation expenses through effective maintenance cleaning?

In this new booklet you will find the answers to those and such other problems as . . .

- Controlling Slime
- Removing Hard Water Scale
- Cleaning Water Lines
- Removing Rust

Then, too, there is valuable information on maintenance cleaning of such allied equipment as . . .

- Evaporative Condensers
- Ammonia Condensers
- Glass Filtering Units
- Finned Air-Wash Coils
- Aluminum Plates and Screens

If you think you could use a copy of this booklet—and the number is F7383—simply put your name and address on a penny post card and mail to Oakite Products, Inc., 22 Thames St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE
Technical Service Representatives Located in Principal Cities of United States and Canada

The bundle of sticks

A wise old man called his quarrelsome sons about him. Taking up a bundle of sticks, he commanded each in turn to break the sticks. All tried, but in vain, and said it could not be done.

"And yet, my boys, nothing is easier to do," said the father, as he undid the bundle and broke the sticks, one by one. "By this example, you can see that united you will be more than a match for your enemies; but if you quarrel and separate, your weakness will put you at the mercy of those who attack you."

The useful truth of this fable is just as timely today as it was when the Greek ex-slave Aesop told it 2,500 years ago. You, a patriot, believing in individual liberty and freedom for all, see our American way of life threatened by the menace of communism abroad and jeopardized at home by complacence, negligence, confusion and incompetence.

As a business leader in your own community, you have a particular responsibility to help unify your fellow citizens and guide their thinking and action--for the strengthening and preservation of the ideals that built America, in fact, made America the envy and goal of the very individuals now seeking to destroy it. *In Union there is Strength.*

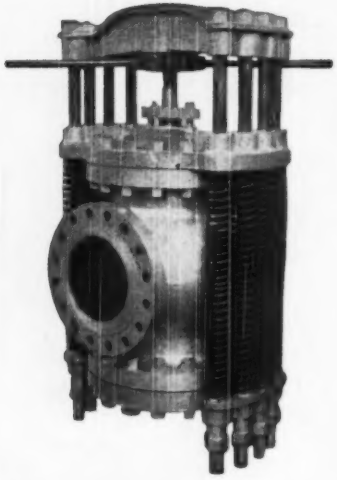
The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York

MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

RAILROAD TRACK SPIKES - CONDUIT - HOT AND COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - RODS - SHEETS - PLATES.

A Valve That Will Interest Every Power Engineer

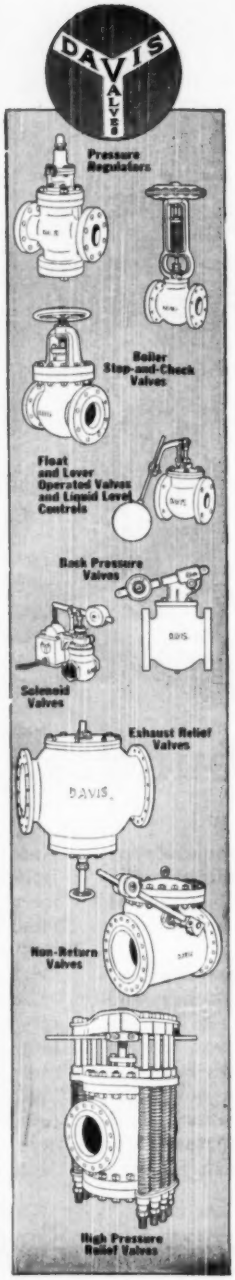


THE DAVIS No. 265 HIGH PRESSURE RELIEF VALVE

USES.—(1) For turbine relief on bleeder system. (2) For protection of any boiler room or process equipment by relief to atmosphere. (3) For relief of high pressure lines to low pressure lines at predetermined pressure. (4) For use in plants carrying multiple boiler pressures to protect lower pressure systems.

ADVANTAGES.—Multiple springs result in less spring accumulation . . . less build-up for maximum relief . . . less blowdown to close. Compact design with springs at sides reduces headroom requirements. Center adjusting screw available for quick, easy change of pressure setting.

BUILT TO REQUIREMENTS.—Offered in sizes from 4" to 30" in semi-steel or steel with bronze or stainless steel trim. Test lever and hold-open device available when desired. Detailed information on request.



DAVIS REGULATOR CO.

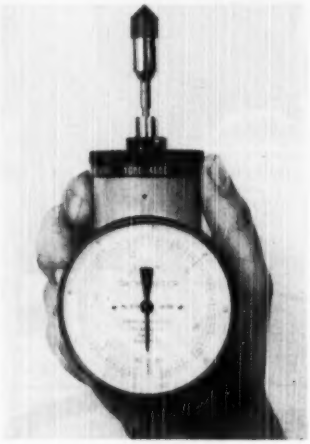
Representatives in All Principal Cities

2540 S. WASHTENAW AVE., CHICAGO 8, ILL.

(Continued from page 192)

For further data on items below, use reply cards on page 192a, identifying your request with letter P and number.

needn't be flared for assembly. Fittings are available in brass, monel, aluminum, steel and stainless steel for tubes ⅛ to 1-in. OD. **Crawford Fitting Co, Cleveland, Ohio.**



HAND TACHOMETER P1150

JAGABI centrifugal tachometers are now protected with a special clutch device to reduce possibility of damage on overspeed. These units are available in one, three and five ranges, for speed measurement from 25 to 4800 rpm.

James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

HOLDING SCREWDRIVER P1119

Here's an end to lost screws and tempers, according to its manufacturer. The *Quick-Wedge* screwdriver with a high-carbon steel blade with hollow-ground bit has a shockproof, unbreakable Tenite II plastic handle. Its special feature is the double spring blade made up of two half-round blades with a movable steel tube. Insert the bit in the screw slot, push the tube forward, and the split blades slide behind each other to give a solid grip on both walls of the slot.

Kidman Co, 233 South 5th West, Salt Lake City 1, Utah.

HAND TACHOMETER P1107

Single-spindle, 3-in.-dial, hand tachometer has quintuple selective range with rotating gear shift. It is made in three different range combinations for speeds 30 to 48,000 rpm, or 15 to 24,000 fmp.

O Zernickow Co, 15 Park Row, New York 7, N. Y.

SPREADER STOKER P1109

Traveling-grate spreader stoker the *Centrafire* has a fuel-burning ability that permits covering a range of 30,000 to over 350,000 lb per hr steaming capacity. Efficient, economical combustion of any bi-

word is spreading

about Foster Wheeler Dual Circulation Steam Generators

The first of a group of Foster Wheeler Dual Circulation Steam Generators was placed in service in May 1948 at a large midwestern refinery. It has been in successful operation ever since and has proved its ability to produce steam of much greater purity than has been hitherto attainable in a boiler of conventional circulation.

Evidence of the increasing acceptance of the Foster Wheeler Dual Circulation Steam Generator is demonstrated by recent additional orders from both the utility and refinery industries.

FOSTER WHEELER CORPORATION
165 BROADWAY, NEW YORK 6, N. Y.

Write for a copy of Bulletin B-50-11 which covers the principles and advantages of Dual Circulation

FOSTER WHEELER

MUNDET

NEW

Heat Saving Efficiency with Mundet Custom Molded 85% Magnesia

Now available in pipe covering and block insulation, Mundet 85% Magnesia permits new heat-saving efficiency. Precision manufacturing on the latest type of automatic equipment insures uniform standards. Extra durability is built into the insulation. It does not "powder," settle or disintegrate. It is unaffected by either steam or water leakage. It maintains an attractive, smooth finish. Precision pipe fit is assured, with no spaces left for the escape of heat.

You benefit from the most modern manufacturing facilities for the production of heat insulation. Write for specification information and recommendations. Mundet Cork Corporation, Insulation Division, 7107 Tonnelle Avenue, North Bergen, N. J.

INSULATION FOR HIGH & LOW TEMPERATURE

Mundet district offices are located in these cities:

ATLANTA
239-41 Elizabeth St., N.E.

BOSTON
57 Regent St., N. Cambridge 40

CHARLOTTE, N. C.
507 S. Cedar St.

CHICAGO 16
2601 Cottage Grove Ave.

CINCINNATI 2
427 West 4th St.

DALLAS 1
601 Second Ave.

DETROIT 21
14401 Prairie St.

HOUSTON 1
Commerce and Palmer Sts.

INDIANAPOLIS
15 E. Washington St.

JACKSONVILLE 6, FLA.
800 E. Bay St.

KANSAS CITY 7, MO.
1428 St. Louis Ave.

LOS ANGELES
(Maywood): 6116 Walker Ave.

NEW ORLEANS 16
315-25 N. Front St.

NEW YORK 17
331 Madison Ave.

PHILADELPHIA 39
856 N. 48th St.

ST. LOUIS 9
3176 Brannon Ave.

SAN FRANCISCO 7
440 Brannon St.

In Canada: Mundet Cork & Insulation, Ltd. 35 Booth Ave., Toronto

For further data on items below, use reply cards on page 192a, identifying your request with letter P and number.

tuminous coal and lignite is possible.

A hydraulic motor-driven overthrow rotor spreads the coal over the forward-moving traveling grate. Effective air seals permit ample opening between grate and bottom of the front wall for discharge of ash from high ash coal.

Westinghouse Elec Corp, 306 Fourth Ave, Pittsburgh 30, Pa.

RESPIRATOR-GOGGLE **P1123**

Combination of the company's No. 700 rubber frame goggle and R200 respirator gives a one-unit protection. Respirator can be fastened with either snap or rivet.

American Optical Co, Southbridge, Mass.

DRY-LUBE PROCESS **P1157**

Process that produces a solid film or "dry" lubricant impregnated into surfaces of metals, plastics, rubber and ceramics to reduce friction and wear. Permanent film is unaffected by exposure to solvents or weather. These processes have already been used in reducing wear in internal combustion engines and other moving parts. They are used in disk clutches, brakes, gears, worms and splines. This lube finish is known as the *Electrofilm Graphite Process.*

Pyrene Mfg Co, 10 Empire St, Newark 5, N. J.

BATTERY CHARGER **P1147**

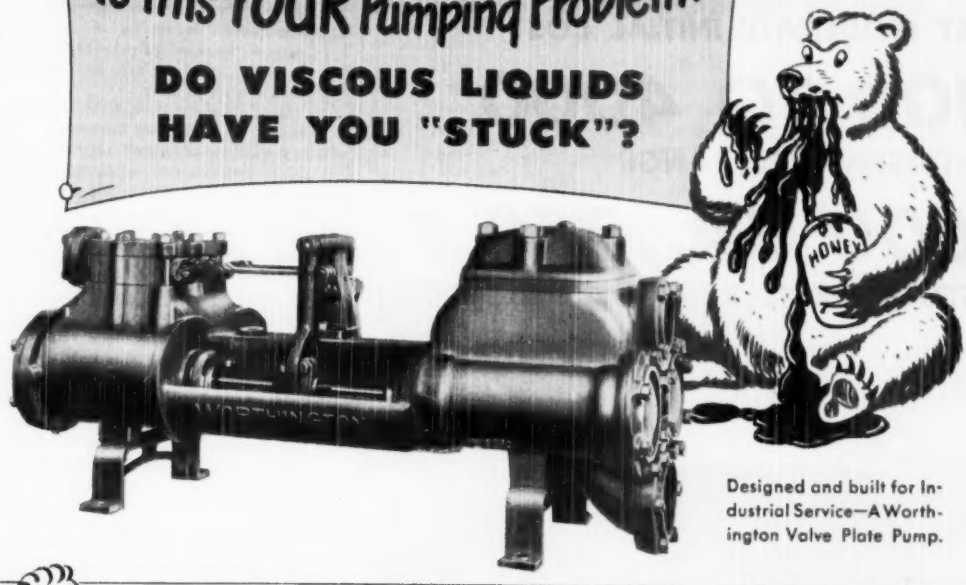
Charging unit consists of mg set with generator control panel and one or more battery charging panels. These units come in groups of 2, 3, 4, or more circuits, and additional charging panels can be added at any time. Incidentally, the motor-generator is rated at 150 kw.

To place a battery on charge a charging plug is inserted in the charging receptacle on the battery or vehicle, and the circuit is closed.

The Hertner Electric Co, 12690 Elmwood Ave, Cleveland 11, Ohio.

Is this YOUR Pumping Problem?

DO VISCOUS LIQUIDS HAVE YOU "STUCK"?



Designed and built for Industrial Service—A Worthington Valve Plate Pump.

Lower pumping speeds may be your answer. This "Viscosity Quiz" tells you why.

Q. *Why reduce reciprocating pump speeds as viscosity increases?*

A. Because friction losses within the pump increase with viscosity and velocity.

Q. *What happens if the friction loss is greater than the available suction head?*

A. The pump won't fill on suction stroke, won't deliver capacity, and erratic pump action and valve slamming will result.

Q. *Pressure is required to lift the suction valves. If valves of lighter material were used, wouldn't the permissible friction loss be increased?*

A. Yes, but only less than ¼ psi — a saving of less than ½ foot of static head (referred to water). Removal, or the use of lighter valve springs may help, but only in borderline cases.

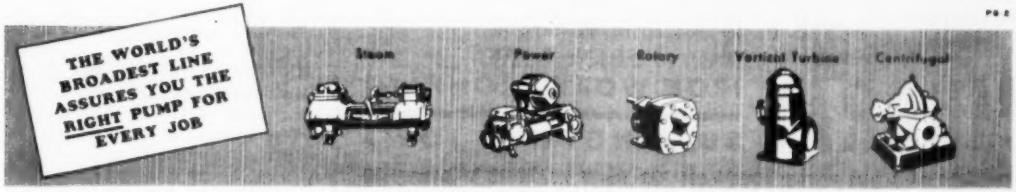
Q. *Are special valves available for viscous liquids?*

A. Yes. Worthington can supply ball valves or the newer "Rollo" semi-spherical valves. The latter combine the advantages of ball valves with spring-return and greater area, providing smooth flow through the seat, unobstructed by ribs or wings.

Worthington Engineers Cut Friction Losses

by eliminating narrow passageways and sharp corners in the design of liquid cylinders, and by providing liberal suction openings and generous valve areas . . . Get further facts proving that in every pumping application *there's more worth in Worthington.* Write to *Worthington Pump and Machinery Corporation, Reciprocating Pump Division, Harrison, N. J.*

WORTHINGTON



ECONOMY
AT MODERATE INITIAL COST
100 TO 4000
HORSEPOWER RANGE
600# GA., 750° F.
STEAM PRESSURES

MURRAY
STEAM TURBINES
TYPE UV MULTISTAGE

The Type UV Multistage Turbine is available in from two to ten pressure stages making Multistage steam economy available at moderate initial cost. Horsepower range is from 100 to 4000, steam pressures up to 600# ga., 750° F., condensing or non-condensing. Several governors and accessories adapt UV Turbines to practically any mechanical drive within the capacity range.

Pictured is a 5 Stage UV Turbine developing 325 HP at 6200 RPM operating condensing. Turbine is equipped with variable speed oil relay governor, pressure lubrication and vacuum breaker, and is in use driving a centrifugal compressor for refrigeration.

Contact your Murray representative for prices and engineering information or write for Bulletin T-122.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

TECHNICAL BRIEFS

(*Continued from page* 138)

and casings have all been worked out and completely detailed. Blueprints can be sent out to the customer and shop immediately on receipt of an order. Many of the standard parts are in regular shop schedule and an adequate stock may be on hand.

Most standard designs are built in smaller capacities and for low-pressure and moderate superheat. They are available in capacities up to about 60,000 lb per hr and from 100- to 400-psi operating pressure. At present a number of manufacturers have standardized units above 60,000 lb per hr. *ASME paper. fall meeting. No number.*

Building Materials

EXTERIOR WALLS FOR INDUSTRIAL BUILDINGS, *by F M Kraus, Structural Engineer, Stadler, Hurter & Co, Montreal, Quebec.* This paper describes and compares ten exterior-wall types as they have been or might be used in industrial-plant construction. Main features of these walls vary according to ease of erection and life desired, local climatic conditions to be met, insulating values required. Capital and maintenance costs that can be afforded. A rating is established on the basis of capital cost.

The trend toward industrialization in the building trade in general, and in mill buildings in particular, sets new goals for the designing and construction engineer. Possible speed and ease of erection, which greatly influence total cost, and the fact that modern industrial buildings are usually frame structures, are actually the governing factors in the design of wall panels.

A prefabricated, precast, or built-up wall has a character of its own. The walls no longer support the floors and the wall panels are supported by the building frame. This characteristic must be borne in mind as some recent experiences have shown that this fact is not always appreciated and that consequently mistakes and misconceptions have hampered progress and economy.

In Canada, where large differences between exterior and interior temperatures are frequently encountered, wall insulation is of primary importance. Insulating properties in some solid brick walls are rather low. Such walls, while as a rule the longest lived and strongest, are poor in insulating qualities. These qualities, or lack of them, are even more marked in solid concrete walls.

There are, however, occasions when a concrete wall may be indicated; that is, when structural considerations prevail over other requirements. It should be necessary to add insulating materials to walls where room temperatures must be

How TIMKEN® bearings lend a hand at tossing 10,000 pounds around

EVERY day is moving day for the 10,000 lb.-capacity Towmotor fork lift truck shown below. It has the heavy duty construction needed to stay on the job with minimum time out for maintenance and repairs. One example of this heavy-duty construction: Timken® tapered roller bearings on the drive wheels, jack shaft, steering wheels, pinion and differential.

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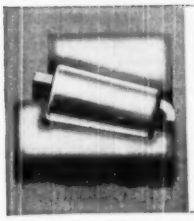
TOWMOTOR CORPORATION *uses Timken bearings on all ten models of fork lift trucks. Photo above shows wheel application.*



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Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer. The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

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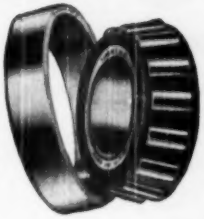

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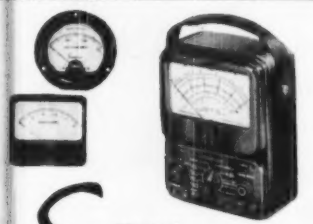

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stable and outside temperatures vary widely.

A schedule of wall types is given in a table for comparison purposes. Estimated costs were independently prepared by two officers, and are for Montreal. Changes in prices of material and labor will, of course, influence these figures, but relatively they are about right.

It is assumed that all walls are satisfactory for their purpose; that is, that they will last as long as necessary, normal maintenance understood, or as long as the equipment they house is up-to-date technically. Such walls should certainly last 40 years without serious defects. *The Engineering Journal*, July, 1950, p 604. *Engineering Institute of Canada, 20-50 Mansfield St, Montreal.*

Meters, Instruments

RADIOACTIVE SNOW GAGE AND RADIO TELEMETERING SYSTEM *by John A Doremus, Motorola, Inc.* In the past, the water content of snow cover in mountainous areas has been measured by a laborious process. Scientists on skis would take samples of the snow at selected locations with long cylindrical tubes and weigh it to determine the average density. Marker poles showed the depth. Water content was determined, of course, as a multiplication of the density by the depth. Many readings had to be taken to determine average snow cover. This process was much too slow to get data on the rate of snow fall or melting.

A revolutionary system was devised by Dr R W Gerdel of the U. S. Weather Bureau and tested last year. Production quantities of the equipment are now being produced for a large installation. In this system, a small sample of radioactive material is buried close to the surface of the ground at the place where measurement is desired. A Geiger-Mueller tube is suspended over the spot and detects the radiation from the sample. As snow falls, it fills the space between the sample and the G-M tube and thereby reduces the radiation. The reduction is a function of the water-content of the snow cover and gives the desired data at one reading.

Impulses from the G-M tube are conducted to a telecoder, which turns these pulses into signals that can readily be transmitted by radio. A frequency-modulated transmitter operates for a certain period each day sending the coded signals to the recording station. Many such stations can be installed and operated in a single coordinated system. Repeater stations each collect the signals from several data-transmitting stations and transmit the signals directly to the recording station. By time sharing, several hundred readings can be taken in a day. At the recording sta-

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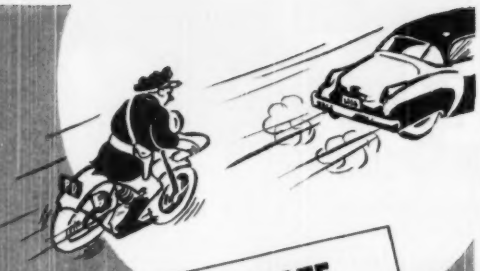

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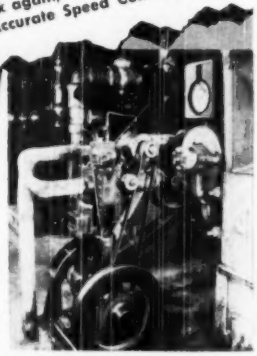

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tion the signals are decoded and turned into impulses that can be counted on a scaler-divider. Counts are recorded on each station every day.

This system will provide an accurate check on the available water from snow in the California mountains; in summer, diligent use of this water makes every gallon worth its weight in oranges. *National Electronics Conference. Illinois Institute of Technology, 3300 S. Federal St., Chicago 16, Ill.*

Water Treatment

THE INHIBITION OF FOAMING, *by Sydney Ross, Rensselaer Polytechnic Institute.* Experimental researches on the subject of insoluble antifoaming agents prompted the initial work behind this paper. Much of the material uncovered in this phase has been published in somewhat briefer form in several technical journals. But it has also been included here, enlarged and combined with a hypothesis that seems to describe most of the observations. The idea behind this inclusion is to present a continuous and connected report on the subject. In addition, it effectively sets the stage for a review of current industrial problems and practices. It is this last phase that carries particular interest for the power engineer.

The author states that while no universal defoaming agent has yet been made or is likely to appear, the new agents have shown themselves able to control foaming in a greater variety of applications than any of the older materials. Modern synthetic agents have almost entirely displaced pine oil, castor oil, linseed oil.

Breakdown of various synthetic agents is given. They include those of the chemical type, fatty acids and fatty acid esters, amines, amides, ethers, phosphate esters, metallic soaps of fatty acids, silicones and other organic silicon materials. *No. 63, Engineering and Science Studies, Rensselaer Polytechnic Institute, Troy, N. Y.*

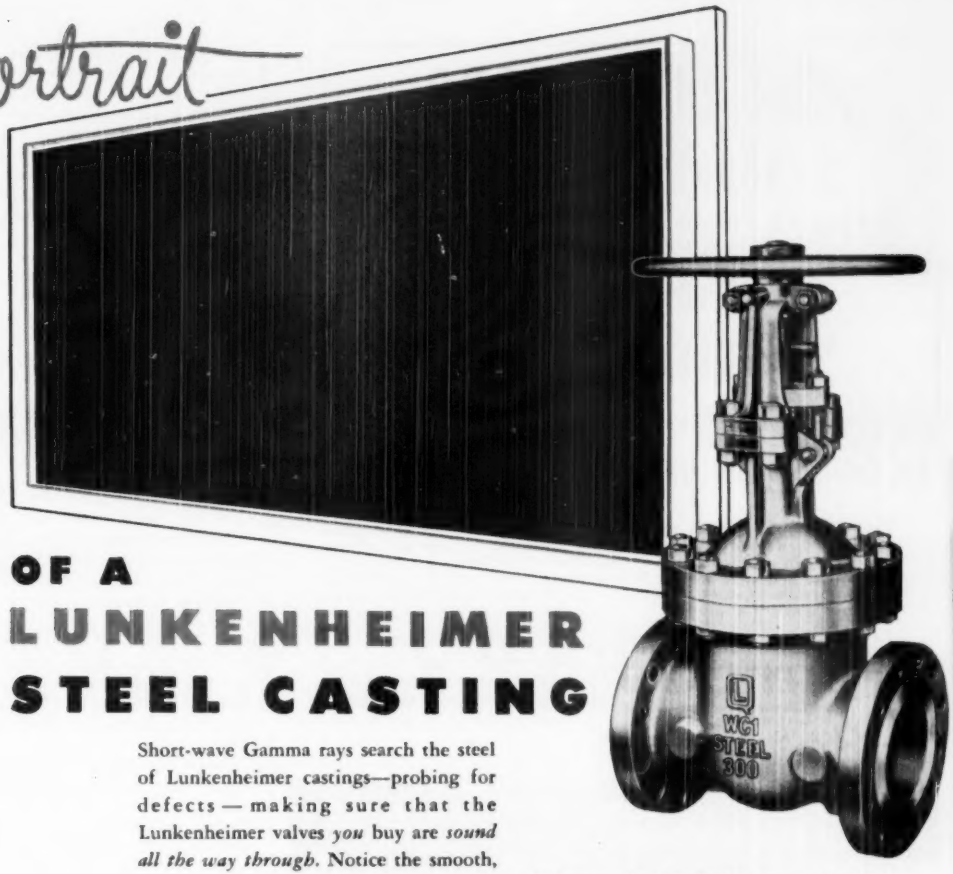
Thermal Unbalance

(*Continued from page 86*)

need to consider the effect of nonuniform rotor heating. Sometimes the proper operating technique must be followed to prevent excessive heat distortion. For example, if a steam turbine spindle is not rotated while the turbine is being heated or cooled, upper surface of the spindle will be at a higher temperature than lower surface. This stems from natural convection; spindle will bow upward.

This effect is also observed on heated rolls or spindles in various industries. It is less commonly observed that the

portrait



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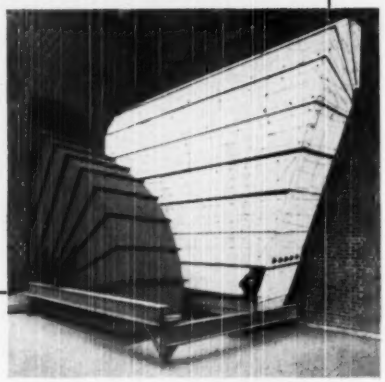

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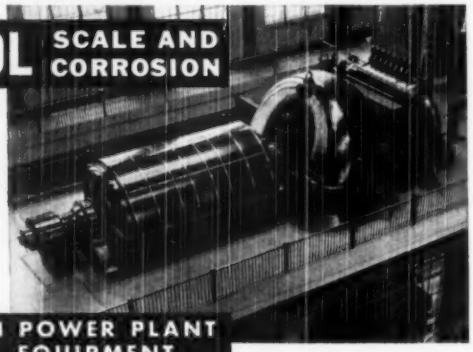

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rotor of an electrical machine will bow upward when the machine is at rest while warm. A long rotor may bow enough under these conditions to cause noticeable vibration when the machine is started, but will diminish after the machine has run a short time. The behavior described above, of course, does not occur on vertical machines.

In another example, a shaft rubbing against a stationary part such as an oil seal will, since perfect concentricity is rare, heat unevenly and warp. If shaft is running below its critical speed the bow will increase the rub. Above the critical speed, the rotor spins about its center of gravity, and the shaft moves away from the rub, causing location of shaft's high spot to shift.

One Plant Serves 40

(*Continued from page* 122)

Results of Program. We've made savings in this power setup. To do so we had to modernize our turbine room. We intend to further increase over-all efficiency by modernization of our boiler room. But savings for our tenants aren't our only motives in power-plant expansion and modernization. We also believe that isolated industrial plants contribute to the effectiveness of the national-defense setup.

During the last war German utility stations were never primary targets for strategic bombing. Any damage to these stations resulted from area bomb attacks, spillover from adjacent primary targets or attack by tactical air forces. Though emphasis wasn't directed at utilities we know from European officials and power men that their system was strained and in a precarious condition. All evidence indicates that had it been attacked systematically the German industrial war machine would have been severely crippled.

When Germany's power became critically short an attempt was made to coordinate all industrial plants with the public "grid" system.

In the U. S. our thousands of medium-size industrial plants represent a pool of emergency power. Capacity of these plants might prevent us from getting into Germany's position if they were all interconnected with the public system. These plants could never carry our entire industrial load, but they could maintain essential services in local areas during periods of failure of utilities.

So we look at our power plant at East Newark Industrial Center as a unit with two jobs. First is to supply low-cost power and steam to our industrial tenants, while the second is to stand ready to help in a national emergency.

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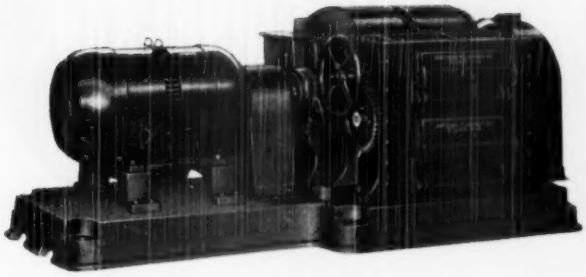

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POWER NEWS

(*Continued from page* 140)

neers, will be under the management of the International Exposition Co with headquarters in the Grand Central Palace. Charles F Roth is manager. E K Stevens, associate manager.

O'Connor Made Associate Editor

When Jim O'Connor joined the POWER staff in 1947, as assistant editor, he brought with him a wealth of practical experience in electrical work, as well as sound engineering training. Familiarity with the tools of the trade came from three years as an electrician and seven more of electrical operation and maintenance with New York City's Board of Transportation. The formal training came the hard way—night courses at New York University. In addition to his engineering degree, he was awarded membership in Eta Kappa Nu, honorary electrical society.

This combination of talents stood him in good stead as he developed POWER's electrical coverage and later branched out to handle lubrication and mechanical transmission. As readers of his articles and special sections will recall, Jim writes in a warmly human fashion, makes his points clearly in good "plain talk." Recognizing these demonstrated abilities, Editor P W Swain recently announced Jim's promotion to Associate Editor.

The Twentieth Century Fund has recently issued a new filmstrip entitled, *Machine-Power Means Plenty*. It drives home the point that our constantly rising productivity and high living standards stem from our use of machine power. Material is based on *America's Needs and Resources*, by J Frederic Dewhurst and Associates. Prints may be obtained from the Text-Film Dept, McGraw-Hill Book Co, 330 W 42nd St, New York 18, for $6, per print.

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not for its own sake but because it

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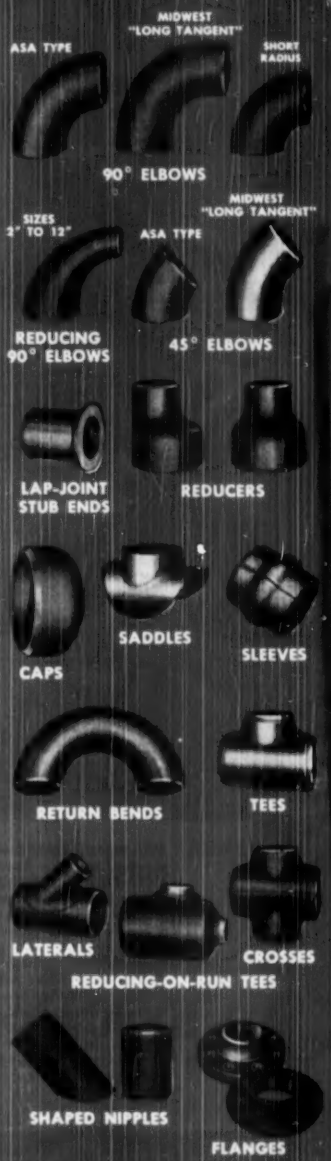
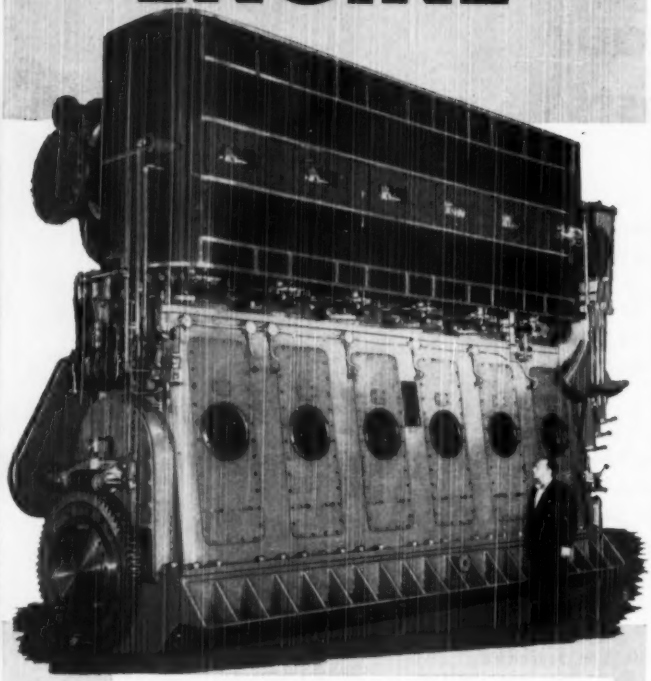


The 12,000th SKINNER ENGINE



This is the 12,000th Skinner engine! It was built for marine service, and is a 23-inch bore x 26-inch stroke, 6-cylinder SKINNER MARINE UNAFLOW STEAM ENGINE. While it is not the largest Skinner Engine ever built, it has a conservative rating of 4000-hp.

For over 80 years SKINNER ENGINES, installed in almost every known industry, have been giving dependable, economical performance in generating electrical power and driving blowers, compressors, refrigeration equipment, pumps and other loads.

In the marine field they have proven their dependability, maneuverability and economy in peace and wartime service, on ocean, river and lake, as the propulsion units of tugs, passenger and railway car ferries, dredges, tankers, bulk carriers, ice breakers, aircraft carriers and express cargo vessels.

For Over 80 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

APPOINTMENTS

Ohio Injector Co announces establishment of 5 major sales divisions, each functioning under a field manager who reports to H G Smith, vice-president in charge of sales. They are as follows: New York div (New York City, southern Connecticut and northern New Jersey)—Daniel J Mooney Jr, New York; Atlantic div (Mobile, Ala., to Portland, Me., excepting New York div area)—Paul E Warner, Philadelphia; Central div (Minneapolis to Buffalo, St. Louis to Pittsburgh)—W G Shepard, Wadsworth, Ohio; Mid-Continent div (Denver to Kansas City, El Paso to New Orleans)—A A Kruse Jr, Dallas; Pacific div (Los Angeles to Seattle)—Denny Gordon, San Francisco.

Newly named sales representatives to **Allis-Chalmers'** general machinery div offices are Donald H McIntosh and Kenneth V Knudsen, Chicago; Delpherd H Verhein, Milwaukee; and Daniel Boland, Davenport, Iowa. In addition, new appointments in the firm's hydraulic dept are: Emil Gross, chief engineer; Frank Jaski, assistant chief engineer; B R Nichols, mechanical engineer; Ralph W Hawkins, assistant mechanical engineer; Paul D Hess, hydraulic engineer; Arthur Bruss, chief draftsman.

General Electric Co reports several changes in its Apparatus Dept as follows: James M Crawford succeeds Robert Paxton as manager of transformer and allied product divs in Pittsfield, Mass. Paxton is now a vice-president and manager of manufacturing policy for the company with offices in New York and Schenectady. He replaces Raymond R Rausch who resigned. In the large motor and generator engineering div Bascom H Cardwell Jr is named assistant manager of engineering. D E Brainard, Howard D Snively, Robert V Shepherd, and Robert W Wieseman are made division engineers. Ab Martin becomes assistant manager of Fort Wayne, Ind. works. Also, William R Boggess will be headquartered at Fort Wayne as assistant manager of sales of GE's fractional horsepower motor divs.

W J Binder has been named manager of engineering service dept of **A M Byers Co,** Pittsburgh, Pa.

Black, Sivalls & Bryson Inc, Kansas City, Mo., announces the resignation of A J Smith, president and director of the company. Kenneth W Lineberry has been elected president.

Elections of Robert L Coe as chairman of the board and Richard C Diehl as president of **Chase Brass & Copper Co,** Waterbury, Conn., have been announced.

De Laval Steam Turbine Co has chosen R M Sorlie Co, Kalamazoo, Mich., as its sales representative in western half of the lower peninsula of Michigan. Also, Robert F Curry has been appointed to De Laval's Detroit office.

Laurence H Carr is named director of engineering and research for **Edward Valves Inc,** East Chicago, Ind. Ralph A Mumert

Progressive

FAIRFIELD

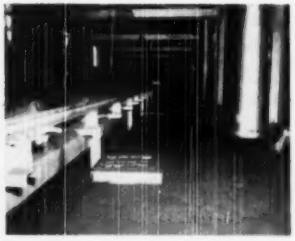
Engineering

SERVING THE NATION'S POWER PLANTS

PLANNED EFFICIENCY AT WORK!!

● There was a time when watch mechanisms were considered intricate, but today's power plant coal handling systems can well share the same distinction. Take the southern rayon plant installation pictured above recently completed by Fairfield. Five conveyors supply coal to the powerhouse bunkers or to optional ground storage in a timed and synchronized capacity cycle. From the time the coal hits the double track hopper until it rests in the bunkers, Fairfield planning and engineering assure the efficient performance of this coal handling system. Take advantage of this outstanding experience and engineering know-how today by calling in your Fairfield engineer.

View down walkway alongside elevator belt. Note extensive ground storage area.



Distributing belt conveyor over bunker. Automatic tripper in background.

THE FAIRFIELD ENGINEERING COMPANY

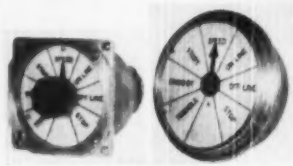
BUILDERS OF DEPENDABLE COAL AND ASH HANDLING EQUIPMENT

335 CHICAGO AVENUE

Marion, Ohio

SIG-TRANS

SIGNAL TRANSMISSION SYSTEMS



4" to 40"

TRANSMITTERS and INDICATORS

for accuracy and reliability

SYNCHRO

SIGNAL TRANSMISSION SYSTEMS

TYPICAL SYSTEMS

- TURBINE ORDER
- LOAD INDICATING
- LIQUID LEVEL
- ROLL LEVEL
- GAS HOLDER
- VALVE POSITION
- DOOR POSITION

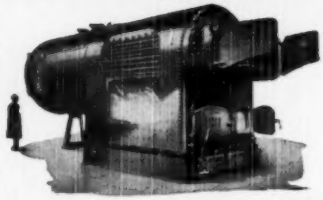
Special Designs Our Specialty

SIG-TRANS, INC.

AMESBURY, MASS.

KEWANEE

HEAVY-DUTY



10 to 304 hp

100, 125 and 150 lbs wp

Has all the characteristics which make firebox boilers ideal for high pressure. Complies fully with ASME and SBI codes.

Outstanding for extra years of dependable service in producing hi-pressure steam economically with Oil, Gas or Coal.

WRITE Department 96-K11
for 6" scale with pipe diameter markings

KEWANEE BOILER CORPORATION

KEWANEE, ILLINOIS

Branches in 60 Cities—Eastern District Office: 60 West 40th Street, New York City 18

Division of American Radiator & Standard Sanitary Corporation

HENSZEY

PACKET-TYPE *Automatic*

CONTINUOUS BLOWDOWN

- Prevents PRIMING
- Prevents FOAMING
- Prevents SLUDGE
- Prevents SCALE

(with simple chemical treatment)

This compact self-contained unit is completely assembled. Can be installed by your own men in hours. It provides completely automatic control of boiler water concentration regardless of variations in boiler load. This is accomplished WITHOUT HEAT LOSS. Maintain clean efficient boilers for substantial savings in fuel, equipment and manpower.

Also...

Standardized or special units for ALL CAPACITIES.

Consult your nearest HENSZEY Representative for FREE Blowdown Chart or write to

HENSZEY

HENSZEY COMPANY

Dept. D11 • Watertown, Wis.

CONTINUOUS BLOWDOWN and BOILER PLANT SPECIALTIES

Boiler Feed Regulators • Distillation Systems • Heat Exchangers • Feed Water Meters

Flow Indicators • Proportioning Valves

Also MILK EVAPORATORS and PREHEATERS

joins F J Hearty & Co of Los Angeles and San Francisco, west coast representative for the firm, as sales engineer. Mumert will make his headquarters in Los Angeles.

Foster Wheeler Corp, New York, promotes Lee Allan Swem to vice-president in charge of its newly formed international division.

Thermal Industrial Engrg Co, 1932 Cherry St, Denver, Colo., headed by Frank T Settle, has been chosen sales representative for **Elgin Softener Corp** in the states of Colorado, Utah, Wyoming, Montana, Idaho, Arizona and New Mexico.

Foxboro Co has opened a branch office at 214 W 10th St, Wilmington, Del., under the managership of Kenneth L Barton. Another office has been established at 225 S 5th St, Minneapolis, Minn., with Robert C Cahill as resident engineer.

Edmund P Lunken, vice-president of **Lunkenheimer Co,** Cincinnati, Ohio, has also been elected secretary. Lunken has succeeded Charles W Burrage, who resigned to devote full time to his present job as manager of sales engineering.

Minneapolis-Honeywell Regulator Co names Jack A Marshall commercial division sales manager for its Southeast region with offices in Atlanta, Ga.

Roy W Maze has been promoted to merchandising sales manager of **Marley Co,** Kansas City, Kansas.

C N Sugden is made assistant director of engineering for gages and instruments for **Manning, Maxwell & Moore Inc,** Bridgeport, Conn. Robert Ingham replaces Sugden as chief engineer for gages.

Plibrico Jointless Firebrick Co announces appointment of Joseph R Sutton as manager of Plibrico Sales & Service Co in Madison, Wis. Sutton succeeds George A Kane who died.

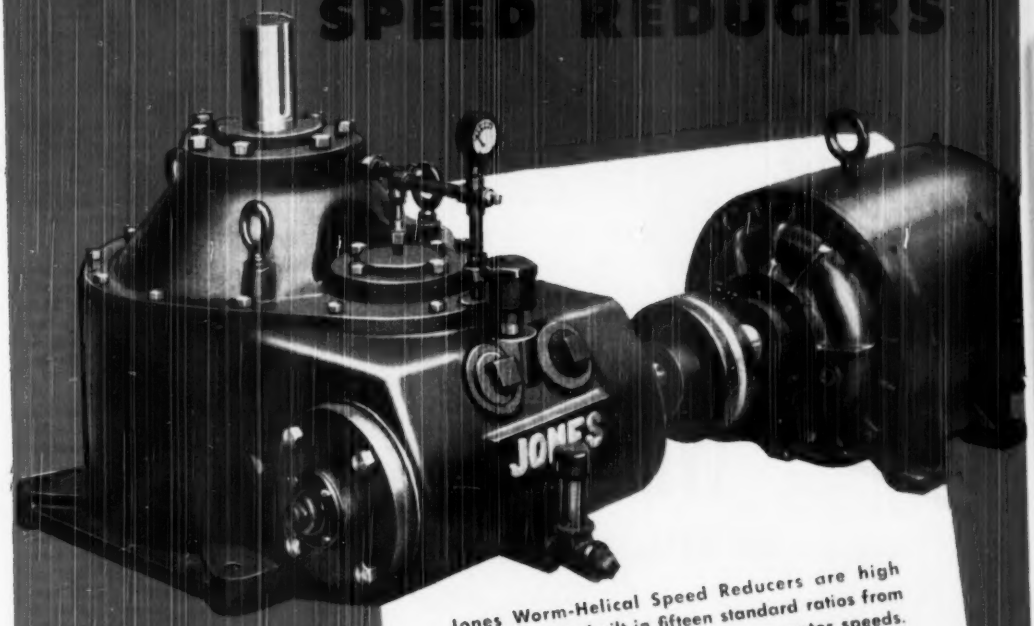
Territorial changes in refractories div of **Norton Co** are reported as follows: William F Winemuller returns to Worcester, Mass., as chief sales engineer. Eugene A Fischer is named refractories engineer for New England and part of New York State, with headquarters in Worcester. Murner E Thor will take over the territory consisting of eastern Canada and part of New York State. He will work out of Buffalo. David G Bolon becomes refractories engineer for territory which includes the principal part of Indiana and the state of Michigan, with the exception of the upper peninsula. His headquarters will be in Detroit.

Pacific Pumps Inc has appointed John Wahlstrand as sales engineer with headquarters in the firm's Houston, Texas office.

James J Hagan and Charles B Denton are now assistant plant manager and advertising manager, respectively, of **Weston Electrical Instrument Corp,** Newark, N. J.

Jones

WORM-HELICAL SPEED REDUCERS



1890 60 YEARS 1950

Jones Worm-Helical Speed Reducers are high efficiency units built in fifteen standard ratios from 40 to 1 to 250 to 1 for all common motor speeds. They are ideal for vertical shaft drives to agitators, mixers, bending rolls, etc.

The low speed shaft can be extended up or down, for coupling connection or gear drive.

Bulletin No. 75 covers complete details.

W. A. JONES FOUNDRY & MACHINE CO.
4423 W. Roosevelt Rd., Chicago 24, Ill.

Since 1890
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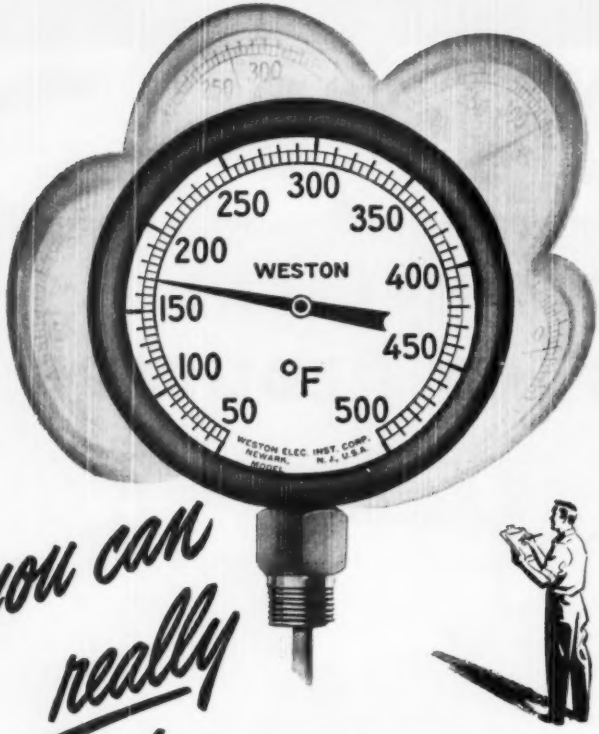
In The Service Of Industry

WORM GEARING — WORMS — SHAFTS — GEAR SPEED REDUCERS
CAST IRON PULLEYS — CUT GEARS — V-BELT SHEAVES
ANTI-FRICTION PILLOW BLOCKS — FLEXIBLE COUPLINGS

ANY WAY YOU LOOK AT IT...



you can really read a **WESTON**

ALL-METAL THERMOMETER

Up in the air, down in a pit, across the shop . . . you can really read the big, open dial of a Weston Thermometer. And because these rugged, all-metal instruments stand exposure, abuse—you know the temperature you read is *right.*

Despite the angle of tank side or pipe, there's a Weston Thermometer to fit it. You can get models with stems that are long or short, that project straight from the back or out the side at any 15° position around the periphery of the thermometer head—whatever you need for *your* application.

Various industrial, *Max-Min, and contact-making types are standard. Consult your Weston representative, or write Weston Electrical Instrument Corporation, 679 Frelinghuysen Avenue, Newark 5, New Jersey . . . makers of Weston and Tagliabue instruments.

*Registered trademark.

WESTON *Instruments*

Sier-Bath Gear & Pump Co has chosen the following as representatives for the Sier-Bath coupling: J R Ruddock & Associates, 7001 N Clark St, Chicago, will cover northeastern Illinois, including the Chicago metropolitan area (bordering counties in Michigan). Volco Co, 622 McKnight Bldg, Minneapolis, will handle states of Minnesota, Iowa, South and North Dakota, northwestern Illinois and peninsula of Michigan. W B Conrad Co, 506 Curtiss Bldg, Detroit, will cover southeastern Michigan.

Thomas A Cleary Sr assumes duties of general superintendent of Campbell works steel plant and Struthers works of **Youngstown Sheet & Tube Co.** He succeeds William H Yeckley who is now assistant to vice-president in charge of operations.

Sarco Co, New York, announces retirement, effective Nov 1, of Gus A Binz, sales promotion manager.

Appointment of the following representatives is made by **Ajax Flexible Coupling Co:** Samson Sales Co, 420 Market St, San Francisco, will represent Ajax flexible couplings, shaler-shakers and Lo-Veyors in northern California. Thurlow Equip Div, G Donald Bradley Co, 4402 White Bldg, Seattle, will cover the states of Washington, Oregon and Idaho on all Ajax products except flexible couplings. Boyd Goodhart, 1425 Troost Ave, Kansas City, Mo., will handle the firm's complete line in western Missouri and Kansas.

M C Larson replaces R A Haworth as manager of **Cutler-Hammer's** Baltimore sales office which will continue as part of Philadelphia district office. Haworth is now Dallas district sales manager and will also supervise the company's Tulsa, Houston, and Midland, Texas sales offices.

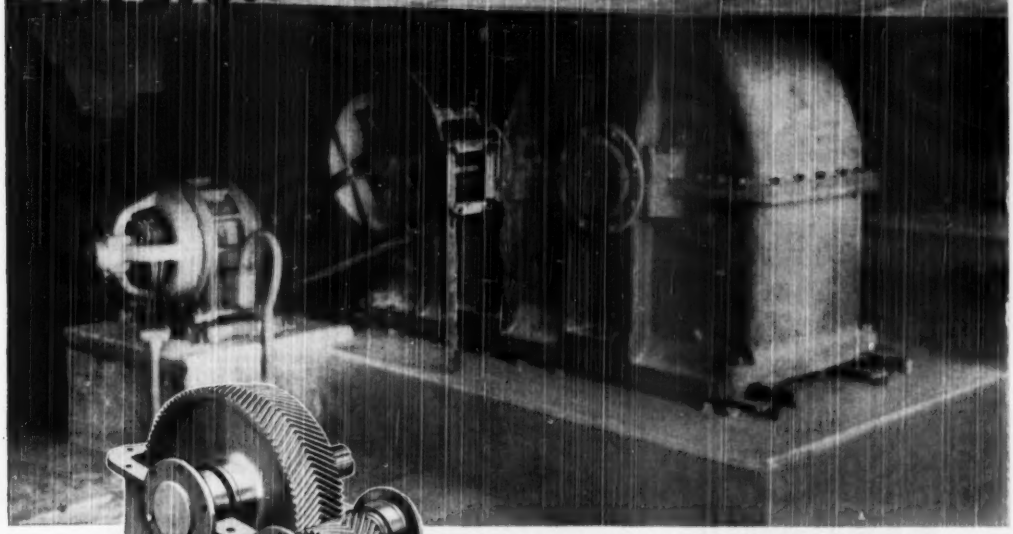
Combustion Control Corp, Cambridge, Mass., designates Lester W Watson as New England sales engineering representative for its Fireye equipment.

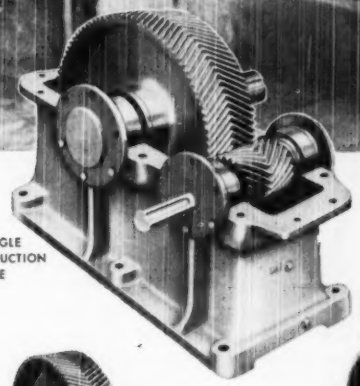
Sales assignments announced by **Carborundum Co** include appointments of John A Decker as sales manager for New York district, and William J Kingsley as assistant sales manager, bonded products and grain div, with headquarters in Niagara Falls, N. Y. Other changes provide for transfer of Thomas Curtiss to central New York area. Edgar T Harris will replace Curtiss as field sales representative in the Buffalo district office. George Dennison becomes special sales engineering representative for New York with headquarters in Buffalo.

General Power Plant Corp announces appointments of the following sales representatives: Spurgeon Co, 23501 Hoover Rd, Van Dyke, Mich., for lower Michigan peninsula area; and Stephan Co, 7016 Euclid Ave, Cleveland, for Ohio area.

Chester F Conner, manager of industrial products sales of **B F Goodrich Co,** Akron, Ohio, has been placed on the company's retirement payroll. Simultaneously, Paul W Van Orden has been named industrial products merchandise manager; Wilfred A Smith, manager of molded, ex-

BALANCED DESIGN MEANS LONGER, TROUBLE FREE SERVICE



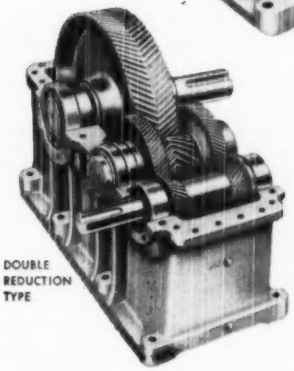


SINGLE REDUCTION TYPE

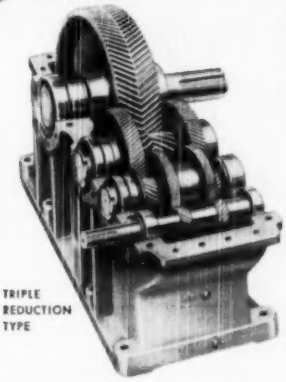
PHILADELPHIA HERRINGBONE SPEED REDUCERS

Because of symmetry of design of these units, the bearings share the load equally. This well planned construction permits the use of 2 standard bearings on each shaft, rather than the usual offset design. The balanced arrangement of the gears further reduces shaft stresses and eliminates end thrusts.

Philadelphia Herringbone Reducers are built in single, double and triple reductions, depending upon the number of gear trains used. Each type covers a wide range of sizes and ratios . . . as standard ratios are from 1.75 to 1 up to 320 to 1, practically any equipment can be provided with the correct operating speeds. These units are also ideal for speed increasing. Efficiencies are obtained up to 98%.



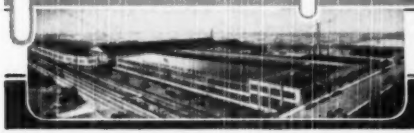
DOUBLE REDUCTION TYPE



TRIPLE REDUCTION TYPE

For complete details about Philadelphia Herringbone Units, send for catalog H-49 . . . use your business letterhead, please.

Philadelphia Gear Works, INC.



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Industrial Gears and Speed Reducers
LimiTorque Valve Controls

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NO WITHHOLDING TAX

ON PERFORMANCE

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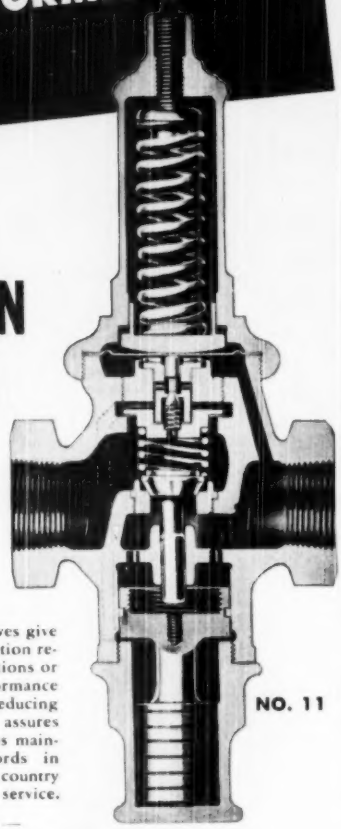
MASONEILAN

REDUCING

VALVES



NO. 11

Masoneilan No. 11 Reducing Valves give you accurate steam pressure regulation regardless of initial pressure fluctuations or changes in demand. Their performance cuts operating expenses by reducing waste. Their rugged construction assures long operating life and minimizes maintenance. Their on-the-job records in countless plants throughout the country show year after year of continuous service.

CHECK THESE FEATURES —

- Stainless steel main valve, auxiliary valve and seat rings are standard . . . at no extra cost.
- Wide range of adjustment without spring change.
- Large capacity due to pilot operation, permits use of smaller size regulators . . . saves in original cost.

Initial pressures up to 250 lbs. reduced to any desired pressure between 5 and 75 lbs. or 75 and 225 lbs. Sizes ½" to 2" bronze; 2½" to 4" iron.

MASON-NEILAN REGULATOR CO.

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Sales Offices or Distributors in the Following Cities: New York • Syracuse • Chicago • St. Louis Philadelphia • Houston • Denver • Pittsburgh • Cleveland • Cincinnati • Tulsa • Atlanta • Detroit Los Angeles • San Francisco • Salt Lake City • El Paso • Boise • Albuquerque • Charlotte, N. C. Mason-Neilan Regulator Co., Ltd., Montreal and Toronto

truded, lathe cut and sponge sales; and George J Fischer, manager of V-belts and packing sales.

J Frederick Keeler has been made vice-president in charge of sales and service of **Orr & Sembower Inc,** Reading, Pa. George H Garraway has been elected vice-president in charge of engineering and production.

Quimby Pump Div, H K Porter Co, has been sold to Warren Steam Pump Co, Warren, Mass.

U S Air Conditioning Corp announces opening of a sales office at 516 Maverick Bldg, San Antonio, Texas, headed by Robert Dawson.

J J Bohmrich has been named group executive over product service, railroad products and welding electrode and equipment divs of **A O Smith Corp,** Milwaukee. J W Spoor has replaced Bohmrich as manager of product service and will also direct operations of the Chicago branch. E R Dickinson has been transferred to the eastern branch at Union, N. J., as manager, succeeding C L Tracey who has moved to New York district office. At the Dallas branch, J A Snyder Jr has replaced D R Neff, who resigned, as manager.

U S Rubber Co appoints Henry A Rome as manager of special products sales; William C Hall, manager of molded goods sales; and Thomas S Savoury, manager of flooring sales for mechanical goods div. All three men have their headquarters in Passaic, N. J. plant.

Stone & Webster Inc announces the formation of a Canadian subsidiary, Stone & Webster Canada, Ltd, 50 King St West, Toronto, Ont. Alfred T Krook is named president of the new company.

Robert H Fite is elected vice-president and general manager of **Florida Power & Light Co.** George C Kinsman rejoins the company as a vice-president. R C Fullerton is also named vice-president.

Central Vermont Public Service Corp has elected Harold L Durgin executive vice-president. He will continue to fulfill his duties as chief engineer.

OBITUARIES

George R Gibbons, 71, director of Aluminum Co of America, died Sept 3 at West Penn Hospital in Pittsburgh, Pa.

William C Dale, 57, president of East Kentucky Rural Electric Coop Corp, died Aug 29 from a heart attack in Shelbyville, Ky.

George A Kane, manager of Plibrico Sales Service Co, Madison, Wis., died Aug 10 in an automobile accident.

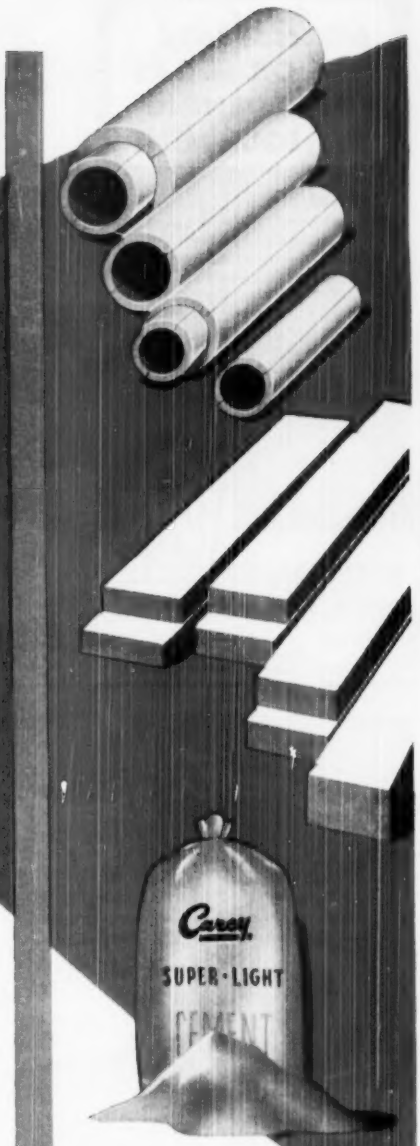
John Selby Parsons, 51, Westinghouse engineer and inventor, died Aug. 22 in Pittsburgh Hospital.

Harry O Warner, 60, director of the dept of electrical engineering, University of Detroit, died Sept 16 of a heart ailment.

Insulation sensation

New Carey "Super-Light" PRECISION-SIZED 85% magnesia!

1. More heat-saving efficiency
2. Extreme light weight slashes application, freight and handling costs
3. Available in new "nesting 0.8" precision-sized pipe coverings — precision-block blocks, and efficient insulating cement form
4. Large semi-cylindrical sections — through 18" pipe size



Carey "Super-Light" is 85% Magnesia in a new, improved, better-than-ever form. Made under a new scientific precision-sized "self-set" method, it combines light weight, chemical purity, dimensional stability, high compressive strength and low thermal conductivity — factors that assure superior performance, extra years of dependable service.

Carey "Super-Light" 85% Magnesia works wonders right from the start. Costs less to apply . . . performs miracles as a fuel-saver . . . increases plant efficiency.

Wherever you are, whatever your insulating needs, you're on your way to new economies, new highs in efficiency with Carey "Super-Light" 85% Magnesia on your job. For more detailed information about this latest **insulation sensation,** write or phone your nearest Carey office, or—

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Carey

industrial
OIL AND GAS BURNING EQUIPMENT

- Mechanical Atomizing Oil Burners
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- Refractory Burner and Muffle Blocks
- Industrial Gas Burners
- Low Air Pressure Oil Burners
- Fuel Oil Pump Sets
- Valves, Strainers, Furnace Windows
- Tandem Block Combustion Units
- Combination Gas and Oil Burners

Detailed information gladly sent you upon request.

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SEE at a GLANCE
the condition of
Furnaces, Pilot Burner*!
***with* CAT'S EYE**
FURNACE INDICATOR
*(Have been televised to Boiler Control Panel)
Ask for full details

ESS INSTRUMENT CO.
BOX 149 BERGENFIELD, N. J.

Monsanto SANTOBRITE controls slime and algae in cooling towers

Slime and algae, enemies of good cooling tower operation, are kept under control by Santobrite (Monsanto's sodium pentachlorophenate, technical). Santobrite is economical...easy to use...efficient.

If slime and algae cause trouble in your cooling towers, it will pay you to read Monsanto Technical Bulletin No. O-15. For your copy, contact the nearest Monsanto Sales Office or write: MONSANTO CHEMICAL COMPANY, Desk A, 1763 South Second Street, St. Louis 4, Missouri.

Santobrite: Reg. U. S. Pat. Off.

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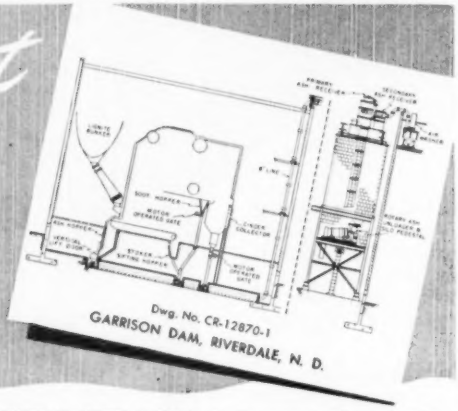
MONSANTO
CHEMICALS — PLASTICS

SERVING INDUSTRY... WHICH SERVES MANKIND

Beaumont

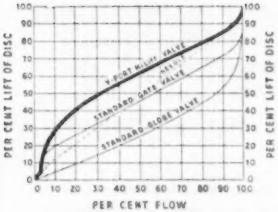
SOLVES LIGNITE ASH HANDLING



At the GARRISON DAM, RIVERDALE, NORTH DAKOTA, this Beaumont installation handles lignite ash and soot with a steam actuated Vac-Veyor System. Under this system, clogging of the venturi and resultant shut-down have been eliminated. Also, as shown above, the air washer is located inside the boiler house; this prevents the water from freezing during North Dakota's sub-zero winter . . . Whether your material handling problem is unusual or not, write today for prints of typical Beaumont installations.

Beaumont **BIRCH COMPANY**
1502 RACE STREET, PHILADELPHIA 2, PA.

DESIGNERS—MANUFACTURERS—ERECTORS BULK MATERIAL HANDLING SYSTEMS


PER CENT LIFT OF DISC
PER CENT FLOW
V-PORT MICRO VALVE
STANDARD GATE VALVE
STANDARD GLOBE VALVE
0 10 20 30 40 50 60 70 80 90 100

Flow characteristics of the Honeywell Hi-Lift Hand Control Valve far surpass those of conventional designs . . . offer favorable comparison to the precision of such diaphragm operated control valves as the Honeywell Series 700.

THE Honeywell Hi-Lift Hand Control Valve is ideal for use where automatic regulation is not necessary or advisable. Designed to afford micrometer adjustment of flow, it contains an indicating scale to show percentage of stem travel to 1% and an inner valve capable of responding to such close correction. Inset illustration shows the simple and easy-to-read scale and the curve at left portrays the superior flow characteristics of the Hi-Lift over conventional valve designs.

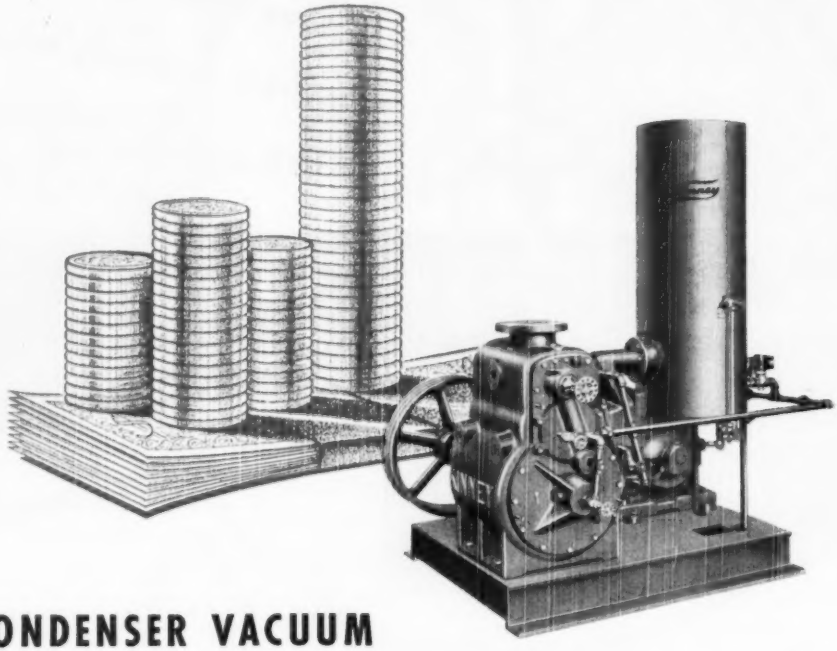
The Honeywell Hi-Lift is available with v-port or parabolic discs . . . in sizes from ¼" to 12" . . . straight through or angle . . . for pressures up to 600 lbs. . . . with body of Bronze, High-Tensile Iron or Cast Steel . . . and with Bronze or Stainless Steel trim. Available, too, with electric motor for remote control applications.

Call in your local Honeywell engineer for detailed information about the Hi-Lift and such other Honeywell Process Control Specialties as: Transfer Valves, Liquid Level Devices, Cylindrical Plug Valves and the Honeywell Space-Saving Bypass. *Write, today, for a copy of Bulletin #242-1!*

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 1900 Windrim Avenue, Philadelphia 44, Pa. Offices in more than 80 principal cities of the United States, Canada and throughout the world.

Honeywell

VALVE PRODUCTS



CONDENSER VACUUM

is measured in dollars and cents

When the chips are down, the true measure of vacuum-producing equipment is *economy*. Which type of equipment — steam jet ejector or mechanical vacuum pump — will maintain the correct condenser vacuum conditions with the least fuss and bother, and *at the lowest cost*? Many of the nation's leading power plants have made this comparison — have measured vacuum in dollars and cents — and have selected KINNEY MECHANICAL VACUUM PUMPS to do the job. Have *you* considered the outstanding advantages which Kinney Vacuum Pumps can bring to *your* plant? Write for "Use of Mechanical Vacuum Pumps in Central Station Operation", an engineering report including installation diagrams. Also ask for Kinney Vacuum Pump Bulletin V45.

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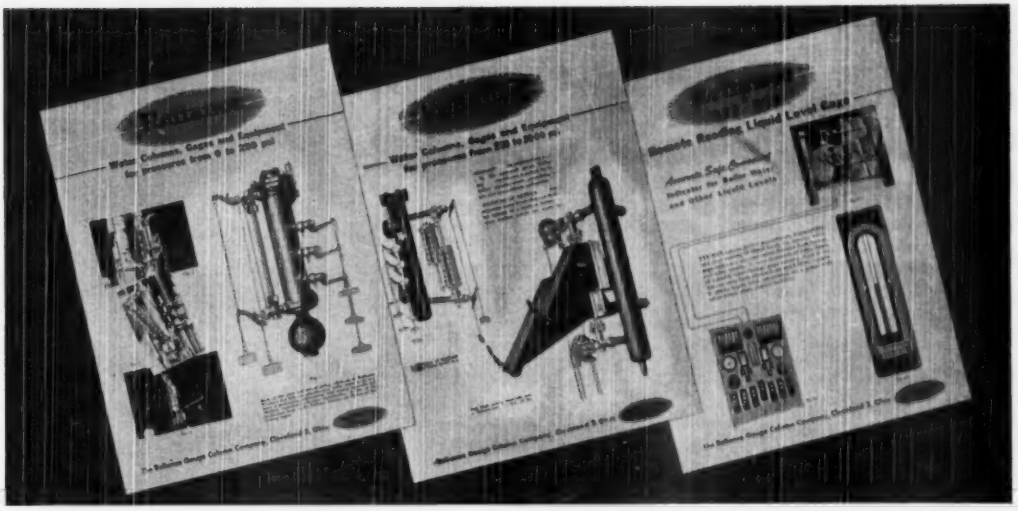

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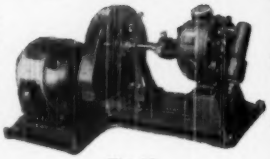

Fig 12

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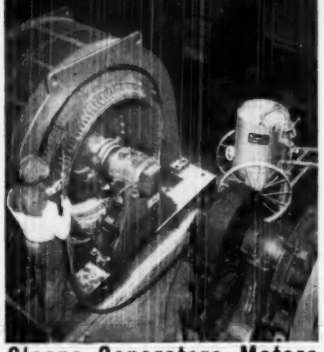

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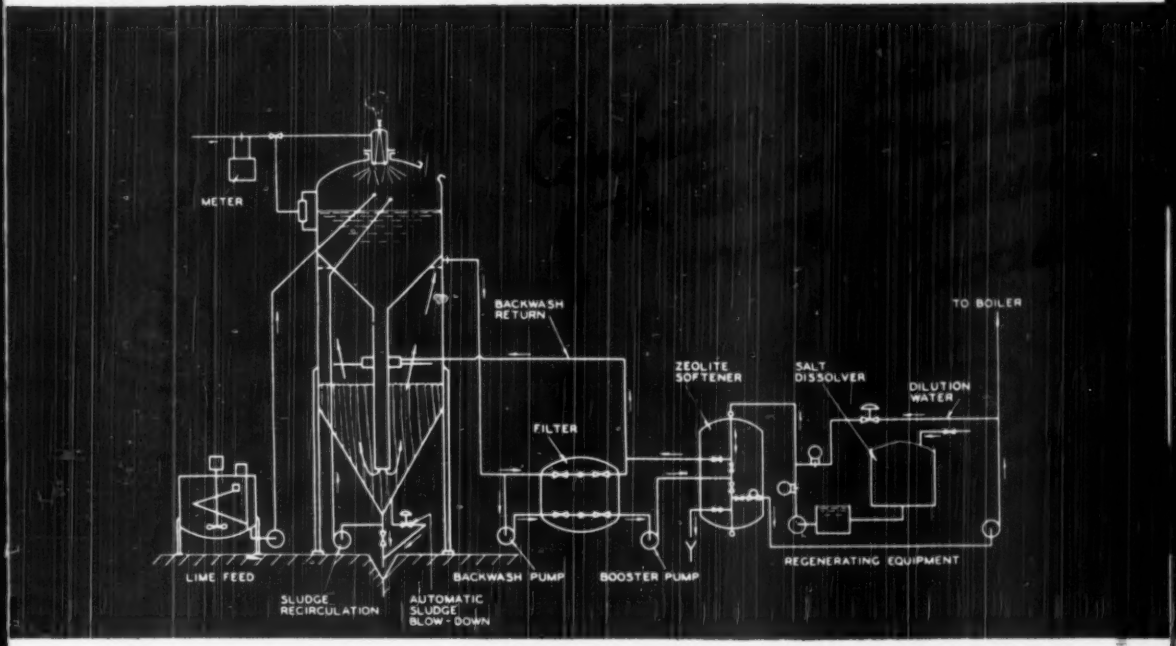

1. saves chemicals
The zeolite softener uses salt instead of the more expensive soda ash and phosphates, bringing down the cost of chemicals considerably.

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R S V P

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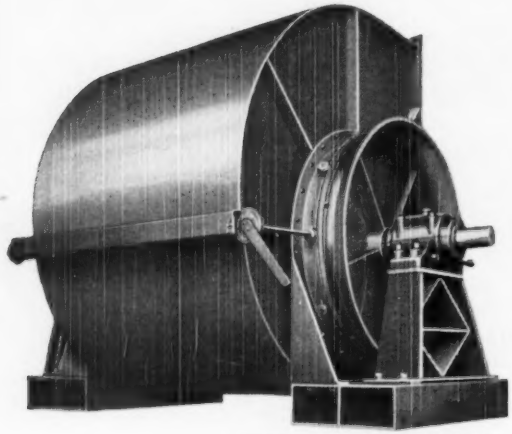
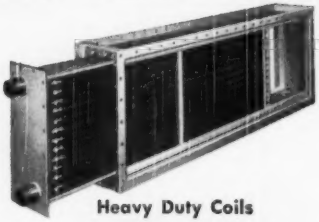
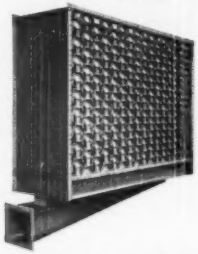


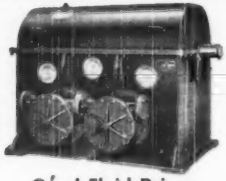
American HS Forced Draft Fan



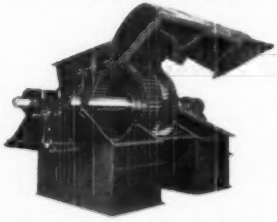
Heavy Duty Coils



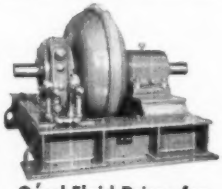
Type ST Fly Ash Precipitators



Gyrol Fluid Drives for Boiler Feed Pumps



Sirocco Induced Draft Fans



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We are particularly proud of our American HS Forced Draft Fan (shown above), designed specially for forced draft applications in power plants.

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We'd like to give you the complete story on our HS Forced Draft Fan, including performance curves, placement suggestions and other important factual data. Just send for our Bulletin 4424 or call our nearest branch office for a copy.

And, if you'd like complete data on other American Blower Mechanical Draft Equipment as well as on Fly Ash Precipitators, Heavy Duty Coils and Gyrol Fluid Drives for fan control and boiler feed pumps—merely write, stating your requirements, or phone our nearest branch office.

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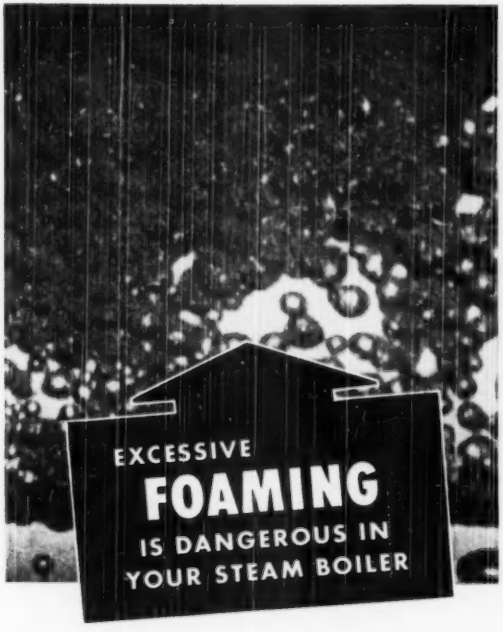

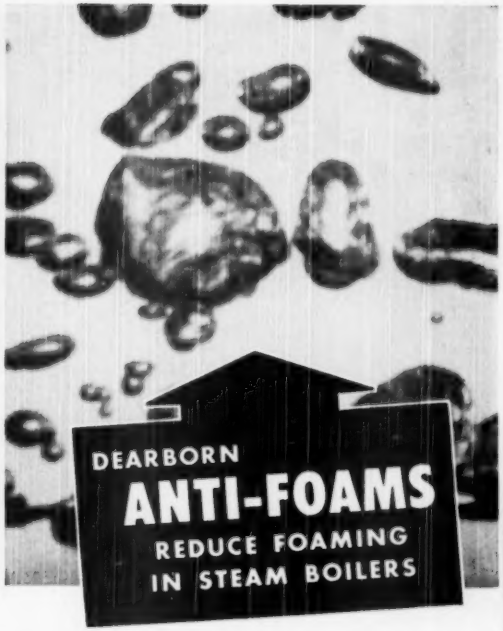

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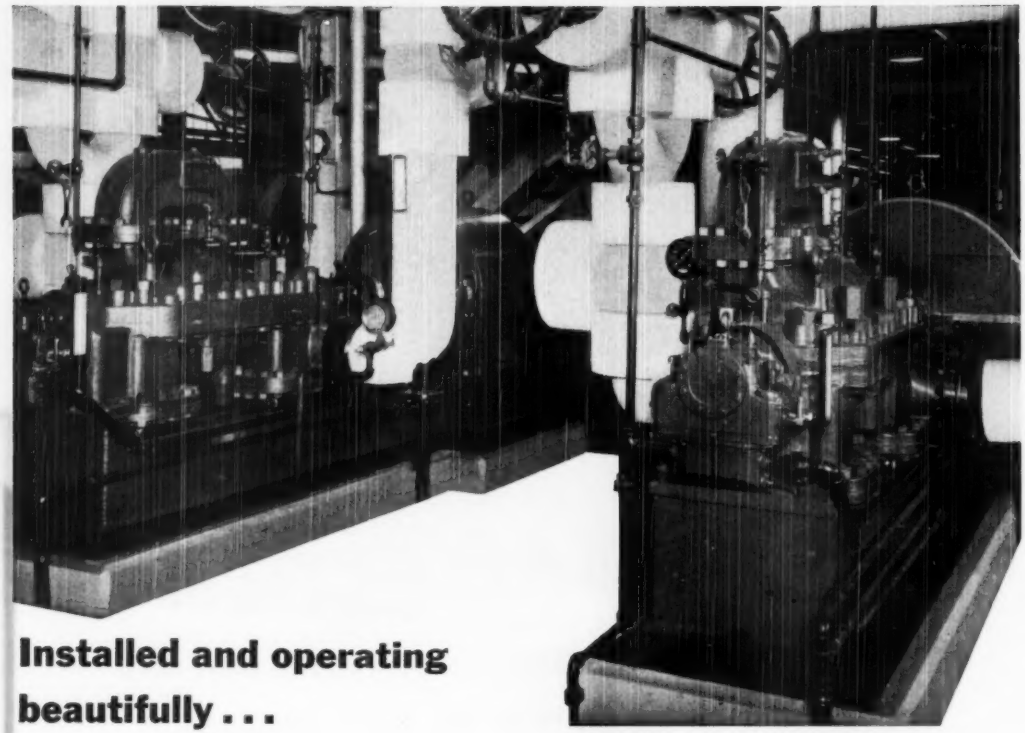

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CENTRAL Maine Power Company has had many years of successful experience with Warren Pumps. Among the recent installations are two Type TH high pressure pumps at their enlarged Mason Steam Plant, Wiscasset, Maine. They are operating at capacities of 325 and 550 g.p.m. against a pressure of 900 p.s.i.g. These pumps are also available with a capacity up to 850 g.p.m. and a pressure range up to 1200 p.s.i.g. • Every construction and material feature of these Warren Pumps contribute to the highest dependability and efficiency, long life and low maintenance, with special emphasis on safety. They will prove a sound investment over the years, as numerous other Warren Pumps have in this and many other central power stations, industrial plants, municipal and Federal projects.

Write for Bulletins 241 and 244 giving complete details on Warren Pumps for higher pressure services. P-12

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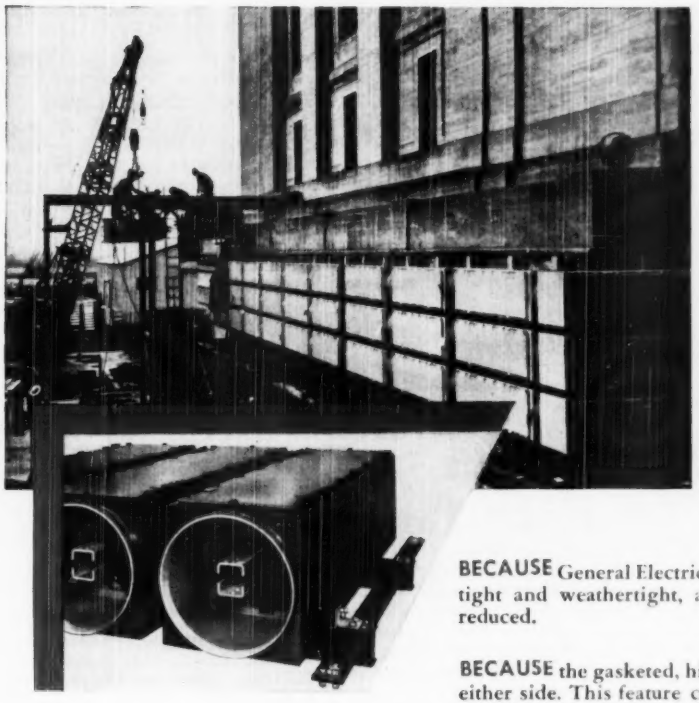

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15 and 23 kv
1200 to 7000 amperes

Your G-E Sales Representative has complete information about isolated-phase bus runs. Ask him for a copy of GEA-5460, a 28-page publication that will aid you in planning your bus runs, or write to *Apparatus Department, General Electric Company, Schenectady 5, New York.*

BECAUSE General Electric isolated-phase bus runs are dust-tight and weathertight, and maintenance costs are thus reduced.

BECAUSE the gasketed, hinged covers can be opened from either side. This feature cuts inspection time and costs by allowing access to the interior of the run from the most convenient position. Cover lugs release the cover without removal of bolts. The cover is swung open on either one of two sets of hinges.

BECAUSE you receive G-E isolated-phase bus runs completely assembled as a three-phase package, including running ground bus. They are installed in a short time at lower predictable costs.

BECAUSE you have one source of responsibility when you order from General Electric—complete co-ordination between planning, engineering, manufacturing, and service facilities to give maximum savings efficiency to the customer.

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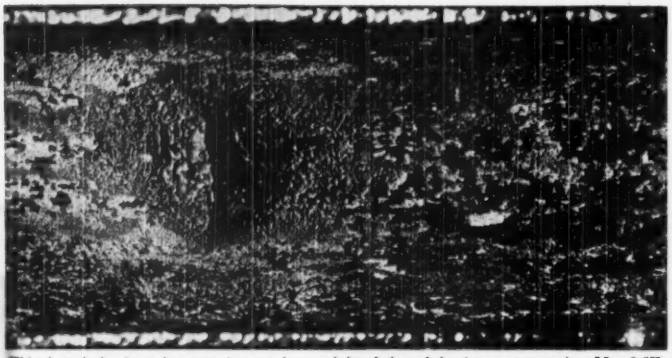
MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" BRASS CO. *Headquarters for BRASS, BRONZE, and COPPER*



This dented aluminum brass condenser tube was injured through impingement corrosion, Mag 2.5X.

Aluminum Brass Doubles Life of Station's Condenser Tubes

The ability of aluminum brass condenser tubes to withstand impingement corrosion far better than Admiralty is evidenced in a study of operating conditions at a seaboard power station.

Prior to 1937, Admiralty tubes had a life of five to seven years at this plant. Failures occurred both from impingement corrosion at the inlet ends of the tubes and dezincification.

Since retubing with aluminum brass, starting in 1937, there have been no tube failures.

The brackish cooling water used contains considerable entrained air. Marine organisms—algae, slime, clams, mussels and fish—are present.

Water velocities are between 6.8 and 7 feet per second. Turbulent flow at this velocity with entrained air is particularly destructive to Admiralty tubes.

Tube Cleaning Eliminated

Although waterboxes and tube sheets are cleaned at intervals, neither plugging nor any other method of tube cleaning has been found necessary.

Marine fouling is controlled through the use of rotating screens and residual chlorination. Two to three times during each eight-hour shift—depending on the season—chlorine is bled through diffusers into the water flowing through the intake tunnel.

As a means of removing as much air as possible, each condenser is vented at the division plate (two-pass type).

One condenser at the plant has an exceptionally turbulent waterbox which has been attributed to the design of the pump, condenser, and piping. Despite this, the aluminum brass tubes installed in 1937 are just starting to show signs of impingement attack at the inlet ends.

Effect of Impingement Corrosion

In impingement corrosion of Admiralty, the normal protective film is rapidly removed until the base metal is exposed. This exposed metal then corrodes away at a much higher rate than normal. In some materials this may be as much as 50 to 100 times more rapid than the normal rate. The depth of the corrosion pits depends upon the length of time that the stream of water strikes the same spot on the tube wall.

Healing of Tube Film Vital

Rapid healing of broken films is an outstanding characteristic of aluminum brass as well as arsenical aluminum bronze and 70-30 cupro nickel. Films on these alloys may readily repair themselves under conditions where an alloy such as Admiralty would not unless the condenser is completely shutdown. This explains why these alloys withstand impingement corrosion so successfully.

Many stations used to have sufficient capacity so that they could shutdown condensers from time to time. These rest periods allowed the films to rebuild themselves in Admiralty tubes and consequently good service was obtained. Nowadays, these shutdowns seldom occur and therefore satisfactory service life cannot be obtained from Admiralty where severe impingement corrosion is a factor. It is important to use those alloys which stand up better under conditions approximating continuous operation.

Dents Lead to Corrosion

Dents formed on the outside of the condenser tube, resulting from improper handling during shipment or installation, can lead to local failure of tubing. Water striking the bump inside the tube may cut through the protective film of even the more resistant alloys and thin the wall locally until perforation occurs. A similar situation occurs when an obstruction lodged in the tube deflects the stream of water against the tube wall.

The scouring effect of water carrying silt or sand—as well as entrained gases—tend to produce wall thinning.

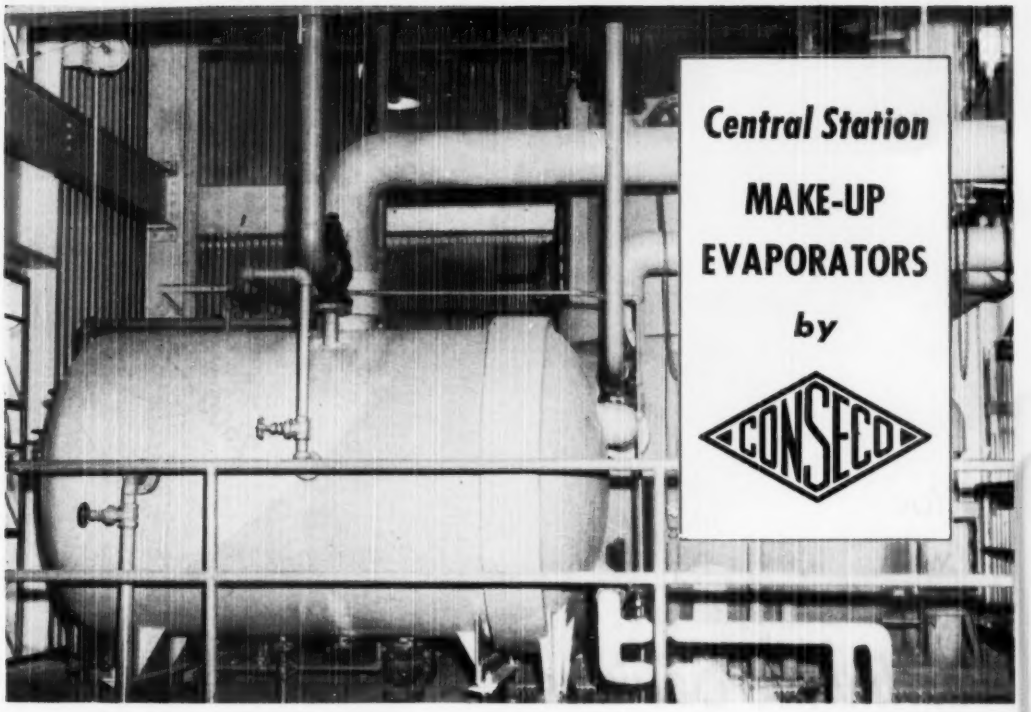
Since water conditions also affect the rate of impingement corrosion, it is advisable to call on the services of Bridgeport laboratory to help select the alloy best suited to your needs. Write for our Condenser Tube Manual containing information on the corrosion resistance and other characteristics of various tube alloys.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

(advertisement)



Central Station MAKE-UP EVAPORATORS by CONSECO

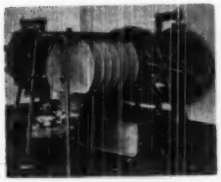
This CONSECO Make-Up Evaporator is installed in a large central station in the Southwest. It is a horizontal internal tube nest unit having a 54" diameter shell 154" long. Its output capacity is 4,000 lbs. vapor per hour at a purity of better than 4 ppm in the condensed vapor. The unit delivers vapor at 22 psia using extraction steam at 62 psia.

To facilitate bundle removal, the bundle is supported on external heavy duty casters and internal tracks.

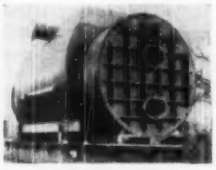
This unit is another typical example of CONSECO'S many contributions to modern design and construction in power plant equipment. It will pay you to consult CONSECO engineers on your requirements.

Write for Bulletins covering Ejectors, Evaporators, Condensers, Coolers, Boilers and Pumps.

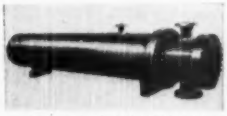
DEAERATORS



REFINER FILTERS



CONDENSERS

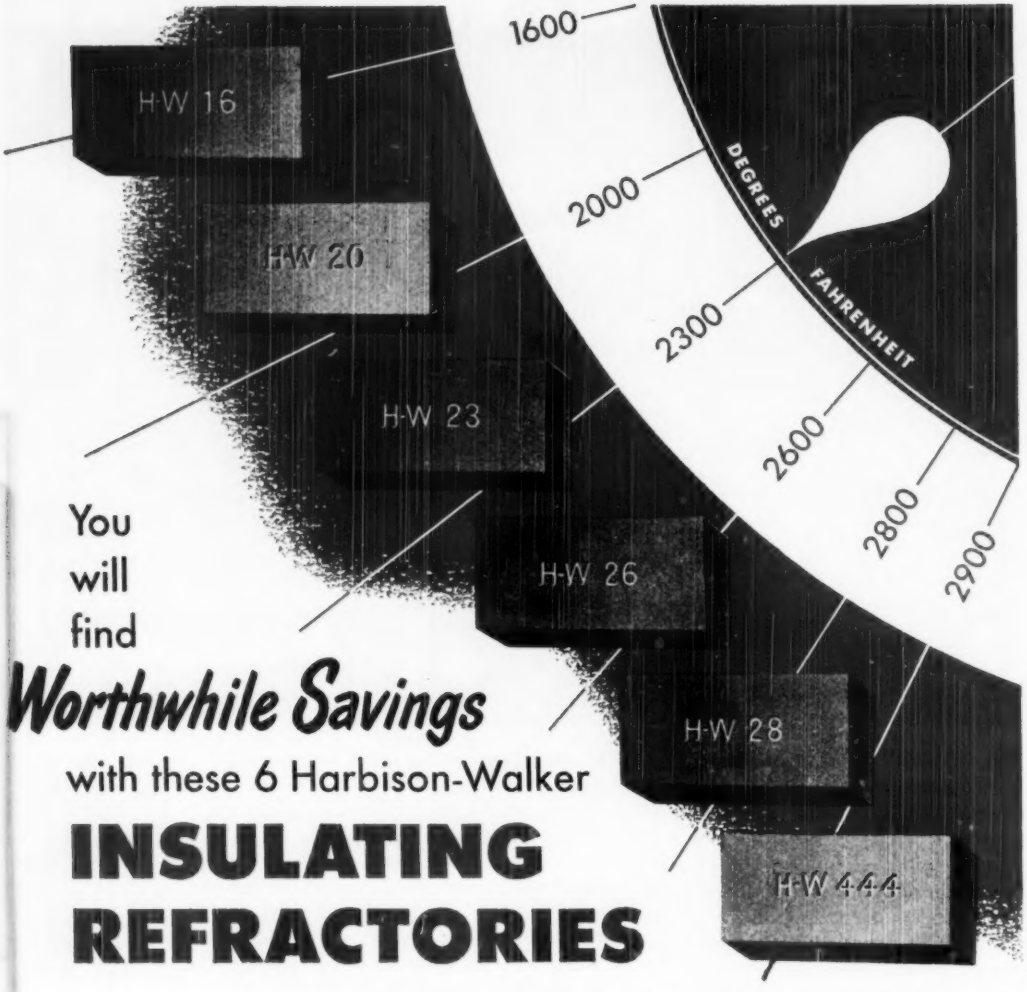


CLOSED HEATERS

STEAM JET AIR EJECTORS

BOILERS

CONSECO **Condenser Service & Engineering Co.**
HOBOKEN, N. J.



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INSULATING REFRACTORIES

The balanced properties of Harbison-Walker Insulating Brick mean superior performance and dependable service. Lightweight, essential to high insulating value and low heat storage, has been attained to the greatest degree consistent with the good mechanical strength necessary for handling and for many furnace structures.

Available in six classes, suitable for service in the temperature ranges indicated above, Harbison-Walker Insulating Brick reduce heat losses, save space, absorb noise, conserve fuel.

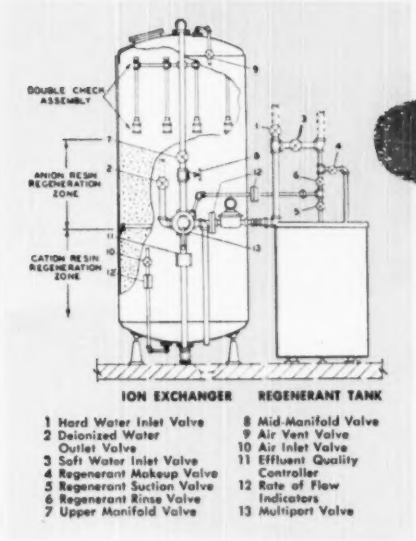
H-W LIGHTWEIGHT and H-W 56 CASTABLES are widely used to great advantage for monolithic structures.

We will gladly send you bulletins containing data and descriptive information about Harbison-Walker Insulating Brick and Insulating Castables.

Harbison-Walker products will be exhibited at the New York Power Show, Booth No 14 Grand Central Palace, Nov. 27-Dec. 2.

HARBISON-WALKER REFRACTORIES COMPANY
AND SUBSIDIARIES
World's Largest Producer of Refractories
GENERAL OFFICES PITTSBURGH 22, PENNSYLVANIA

Highest Quality Mineral-Free Water At FRACTION of Evaporated Water Cost



ELGIN Mono Flo DEIONIZER

(single tank unit)

Only 18c* per 1000 gallons compared with $5.00 per 1000 gallons for evaporated water

*Based on 10 grain water

SOME OF OUR OTHER PRODUCTS

- Zeolite Water Softeners
- Dealkalizers
- Silica Removers
- Degasitors
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Here is a truly revolutionary development—a single tank "monobed" deionizer that brings the cost of high quality demineralized water within the range of those who have heretofore found evaporated or distilled water prohibitive in cost. Here is the perfect boiler feedwater that assures freedom from scale, corrosion, carryover and costly blowdown. Yet the overall cost is comparable with ordinary water conditioning equipment or treatments.

The single column Elgin Deionizer produces water of higher quality than delivered by two and four-column demineralizers. In fact, for nearly all purposes, the water is freer from impurities than *distilled* water — and at a fraction of the cost. Naturally the compact Elgin MonoFlo Deionizer costs far less to buy and operate. It requires but little space — is simple in operation — cuts regeneration time and rinse water requirements — and has other notable Elgin features which make it today's outstanding deionizing equipment.

Similar in design and function, but utilizing different ion-exchange resins, the Elgin Ultra-Deionizer also *completely removes silica and CO_2.*

These Deionizers incorporate the famous Elgin "Double Check" manifold assembly which permits the use of a deeper bed of ion-exchange resins without loss — giving a marked increase in demineralized water output.

Write today for detailed information

ELGIN SOFTENER CORPORATION

130 North Grove Avenue, Elgin, Illinois

ELGIN ECONOMICAL WATER CONDITIONING SINCE 1908

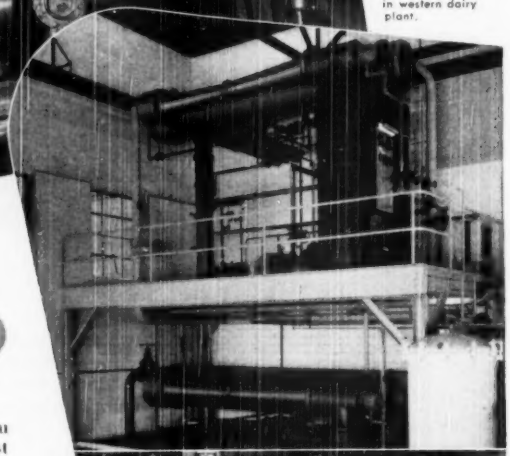
Water Conditioning Since 1908

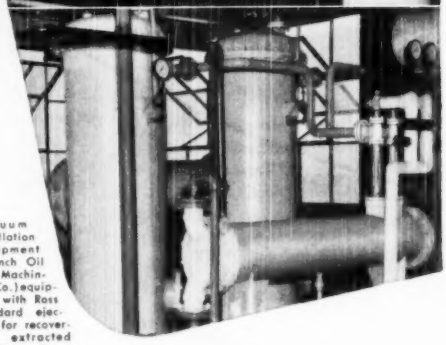
Special or normal . . .

YOUR CONDITIONS ARE STANDARD HERE

Test Rack, equipped with Ross standard ejectors, for a wide range of operating conditions.

Two Ross Decalorators (vacuum refrigerating units) in western dairy plant.





Vacuum distillation equipment (French Oil Mill Machinery Co.) equipped with Ross standard ejectors, for recovering extracted soy bean oil.

ROSS

STEAM JET EJECTORS

Your conditions may be classed "special", or you may consider them "normal". But to Ross, most conditions are *standard*, are quickly met by long, diversified engineering experience . . . highly developed plant skills.

For during the many years that Ross has been designing and fabricating steam jet ejectors . . . starting with their use on surface condensers and following with the more general, industrial applications on vacuum refrigeration, vacuum distillation and oil deodorizing equipment, Ross engineers have gained the position *and the reputation* of dealing with *any* problem quickly, practicably, economically.

As a result of such experience, Ross has been able to standardize ejectors . . . to establish a series of standard frame sizes. Therefore, by simply selecting the most suitable size steam nozzle and other parts, normal requirements can be quickly accommodated. And by the same token, so-called "special" conditions are quickly met, too . . . some through modification of standard units . . . others through individualized engineering and fabrication.

GAIN TIME — Wide experience enables Ross engineers to be of genuine assistance to you . . . whether your conditions call for single or multi-stage units, with or without surface or barometric inter and after condensers. Feel free to consult.

ROSS HEATER & MFG. CO., INC. Division of American Radiator & Standard Sanitary Corporation **1415 West Ave. Buffalo 13, N. Y.**

In Canada, Horton Steel Works, Limited, Fort Erie, Ont.

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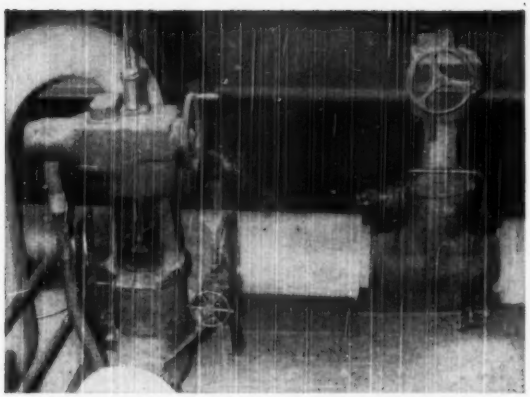
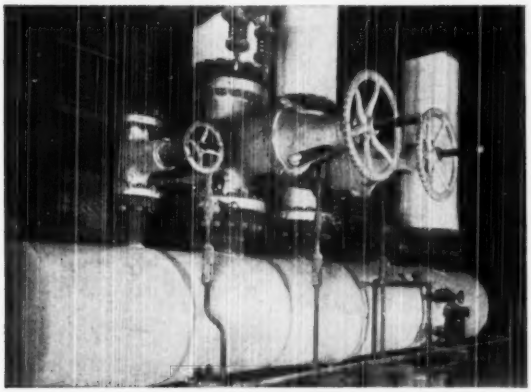
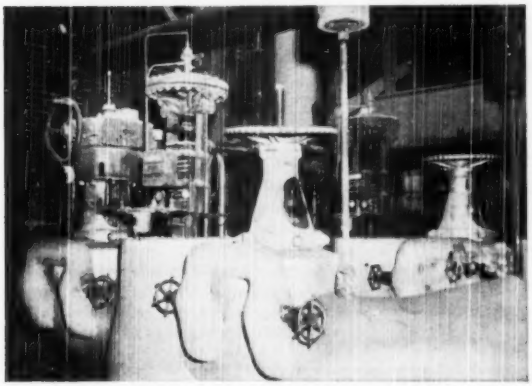


Walworth Motor Operated Series 900 Pressure-Seal Cast Steel Gate Valves.



Walworth Series 600 Pressure-Seal Cast Steel Gate Valves.



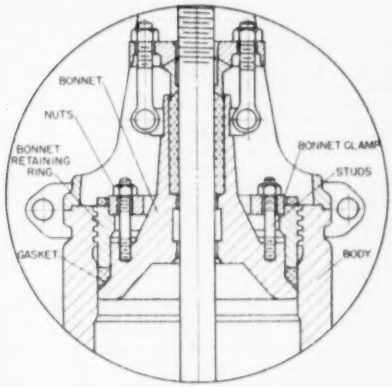
Manually operated and motor operated Walworth Series 900 Pressure-Seal Cast Steel Gate Valves.

WALWORTH PRESSURE-SEAL CAST STEEL VALVES

The bonnet and body design of Walworth Pressure-Seal Valves is such that the pressure within the valve is used to prevent leakage at the junction of the bonnet and body. Sudden temperature and pressure changes do not affect this tightness. Bonnet flanges and studs are eliminated and the weight of the valve is reduced.

An improved disc design provides flexibility, and helps keep seats tight, even when the valve body may be distorted by pipeline stresses, or by temperature and pressure changes. This improved disc design makes it easier to open and close this valve.

Walworth Pressure-Seal Valves are easy to disassemble and assemble, and are the most satisfactory valves for high-pressure, high-temperature service. They are available in Series 600, 900, and 1500 and in a wide range of sizes and types. For further information, see your nearest Walworth Distributor, or write: Walworth Company, 60 East 42nd Street, New York 17, N. Y.



A cross section of the bonnet joint assembly of a Walworth Pressure-Seal Cast Steel Gate Valve. The internal pressure is utilized to make the body-to-bonnet joint tight.

WALWORTH
valves and fittings
60 EAST 42nd STREET, NEW YORK 17, N. Y.

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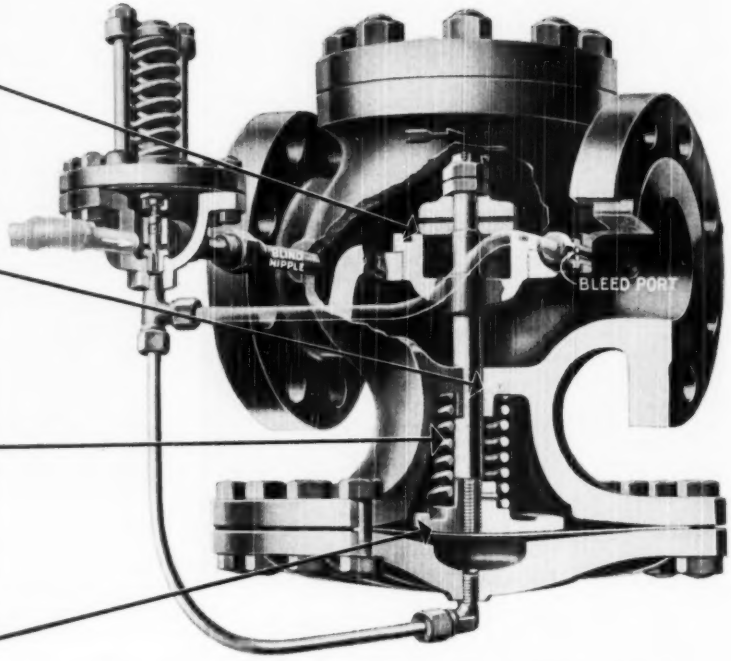
WHY Spence Regulators Outlast The Field

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. More than *twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.



Spence Type EQ back pressure regulator — operation of main valve is controlled by a sensitive pilot to regulate the initial pressure. Same pilot is used with all sizes of main valves.

The features shown above explain why you profit on every important count with Spence Pressure and Temperature Regulators.

Learn more about these and many other advantages of Spence Regulators by sending for Bulletin 350.

DURABILITY — Spence Regulators perform dependably year after year.

ACCURACY — You can be sure of accurate control for the life of the regulator.

MAINTENANCE — You don't need expensive repairs or special maintenance. That means less down-time, less time and money wasted on replacement of parts.

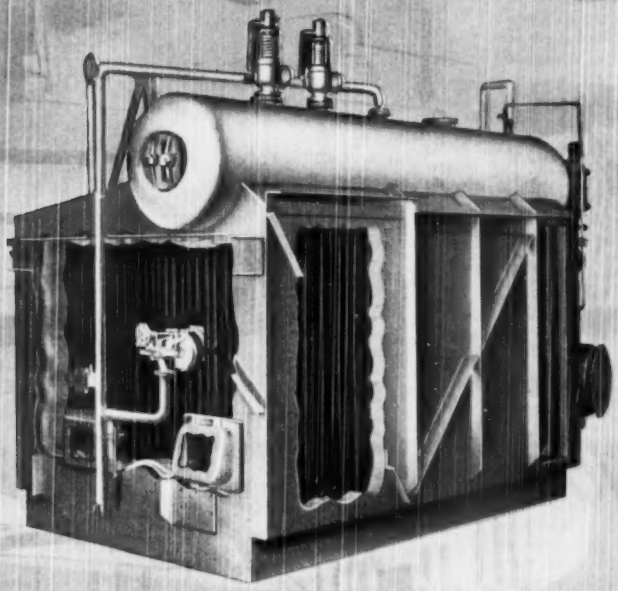
SE-110

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

Spence

"Package" with a "Pedigree"

Foster Wheeler—first in the design and fabrication of Water-tube Package Steam Generators



Units up to 30,000 lb per hr for both small and medium size plants

Foster Wheeler was building portable Water-tube Package Steam Generators as far back as 1940. Today, mounting orders from leading industries throughout the country testify to the fact that Foster Wheeler Package Steam Generators are "doing the job." These versatile units, which assure higher efficiency and real economy in the cost of steam production, reflect the broad background of Foster Wheeler industrial and central station experience. They are easily installed by means of a few service connections and are adaptable to various fuel and firing arrangements.

Let us show you how to modernize your plant the Foster Wheeler way at relatively low cost. *For further information, write...*

FOSTER WHEELER CORPORATION **165 BROADWAY, NEW YORK 6, N. Y.**

FOSTER WHEELER

No job is too unusual for NAVCO

Whether you require a simple pipe bend or a complicated prefabricated assembly Navco can help you. As shown above, Navco Shops are equipped to handle Chrome Moly, Stainless, Carbon Steel and Copper, in addition to any of the many other Ferrous and Non-Ferrous materials.

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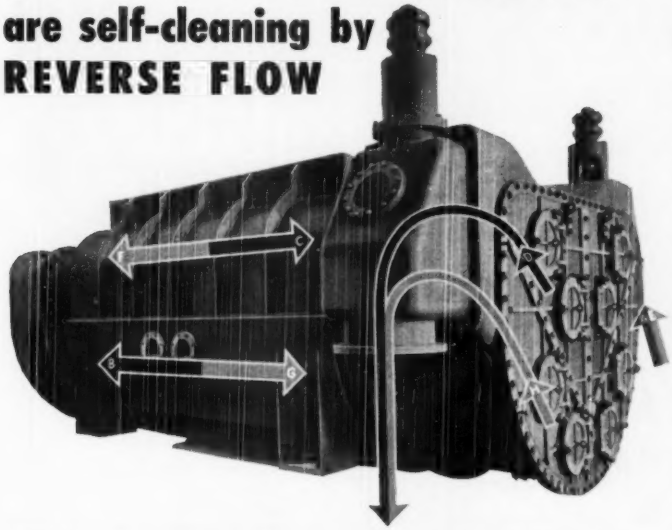
NOTES for the Power Engineer

C. H. Wheeler OF PHILADELPHIA

STEAM CONDENSERS—STEAM JET EJECTORS—COOLING TOWERS—VACUUM REFRIGERATION—HIGH VACUUM
PROCESS EQUIPMENT—MICRO-PARTICLE REDUCTION MILLS—MARINE CONDENSERS & EJECTORS—DECK MACHINERY

C. H. Wheeler CONDENSERS are self-cleaning by REVERSE FLOW



End Downtime for Cleaning Maintain Constant Full Load

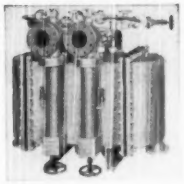
Now you can end your troubles with clogged tube sheets. No longer need you shut down a steam condenser while a conglomerate of refuse—vegetable, animal and mineral—is laboriously removed by slow hand methods.

C. H. Wheeler has developed a simplified method for *reversing* the flow of cooling water in either single or divided water box condenser designs. Rapid reversal of cooling water flow effects a sudden change in temperature which shocks and dislodges marine growth. The physical force of the water flushes this and all other debris, including sand and muck, down the discharge.

The self-cleaning reverse flow is accomplished in new C. H. Wheeler condensers by built-in valves or sluice gates. A push button performs the flow-reversing operation. What formerly took hours is now accomplished in a matter of minutes with no interruption in load.

If you don't need a *new*, integrally built, Self-Cleaning Condenser, C. H. Wheeler can apply the Reverse-Flow principle to other steam condenser installations by means of external piping and four-way valves. Your correspondence is invited. C. H. Wheeler is "Ahead in Condenser Development."

STEEL SHELL TUBEJET AIR EJECTORS MORE RELIABLE . . . SAVE SPACE



Engineers' fears of porous castings have led many to specify separate inter-after condensers with air ejectors. These fears are now totally dispelled with the new C.H. Wheeler Steel Shell Tubejet Air Ejectors. Designed originally to attain compactness for marine installations, thousands of these ejectors rendered outstanding service in World War II. This streamlined version of the older design effects considerable savings in space and weight. They are being widely adopted for stationary power plant use. Available with either single or multiple element, two-stage type with combined surface inter-after condenser. The coupon will bring you Specification 88, just released. It shows preferred method of piping to control hotwell level in main condenser.

THIS NEW CATALOG WILL BRING YOUR CONDENSER INFORMATION UP-TO-DATE

C. H. Wheeler Mfg. Co.,
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Name .....

Department .....

Company .....

Address .....

Please mail me file material on C. H. Wheeler

☐ Self-Cleaning Condensers ☐ Tubejets (Specification 88)

C. H. WHEELER MANUFACTURING CO., 1800 SEDGLEY AVE., PHILADELPHIA 32, PA.

REPRESENTATIVES IN MOST PRINCIPAL CITIES

ALL THE CAPACITY
ALL THE VERSATILITY
ALL THE POWER
ALL THE EFFICIENCY

OF A DEEP WELL PUMP FOR SHORT OR MEDIUM SETTINGS

REQUEST FREE BULLETIN
Describing and illustrating Peerless close-coupled pumps. Request Bulletin B-159.

PEERLESS PUMPS

PEERLESS *Close-Coupled* VERTICAL TURBINE PUMPS

CHARACTERISTICS AT A GLANCE:

HEADS
Up to 1000 feet

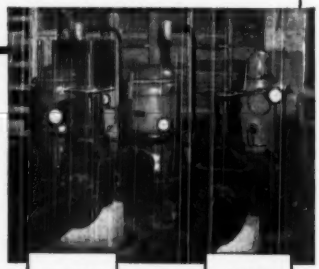
CAPACITIES
Up to 30,000 g.p.m.

H.P. RANGE
Up to 2,500 h.p.

DRIVES
As required; standard electric vertical hollowshaft or solid shaft motors; right angle gear drive; V- or flat belt; combination units.

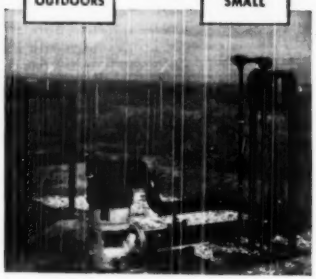
LUBRICATION
Choice of oil or water lubrication.

NO PRIMING PROBLEMS



INDOORS OR OUTDOORS

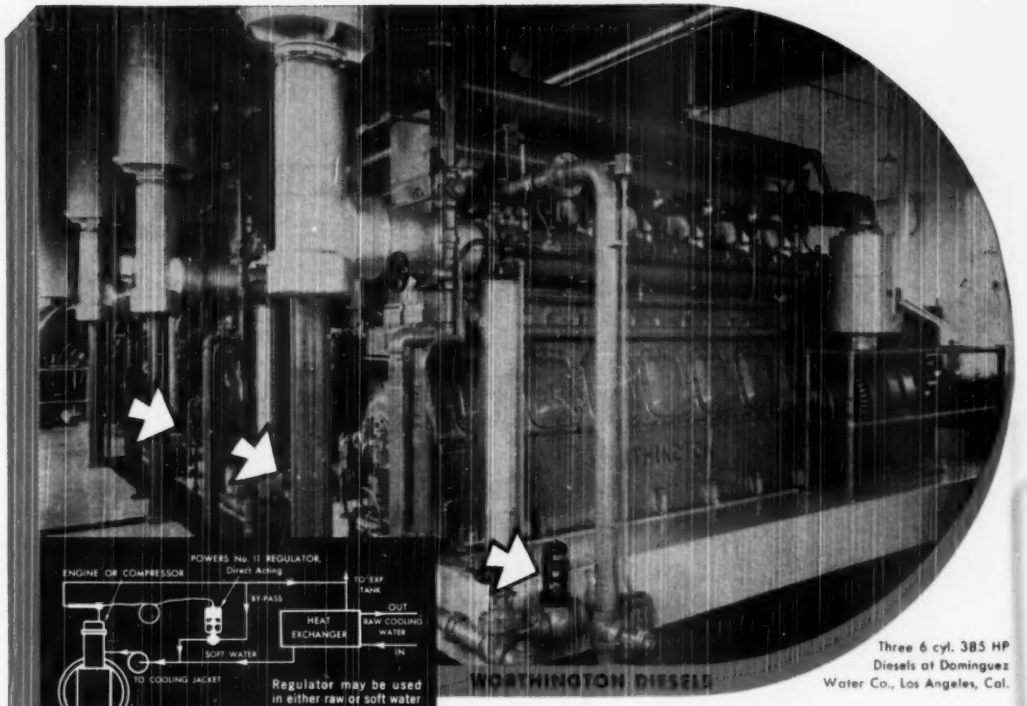
LARGE OR SMALL



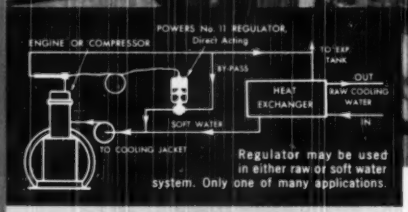
SPACE SAVING VERTICAL PUMP FOR BASINS, SUMPS, RESERVOIRS AND SURFACE WATER SOURCES SUCH AS RIVERS, LAKES, PONDS

This successful, close-coupled, modification of the Peerless vertical deep well turbine pump, for industrial processes, embodies all the outstanding design and performance characteristics which have made Peerless the leader in the sale of vertical, deep well turbine pumps. Peerless vertical close-coupled turbine pumps are economically applied to a widest range of municipal, industrial and commercial water lifting or boosting and circulation processes, where short or medium pump settings are involved. Plan with Peerless to get the power, capacity and utility of this vertical space-saving pump that will cut your pump overhead with measurable savings. Descriptive Bulletin No. B-159 describes and illustrates its design, performance and applications, write for it today.

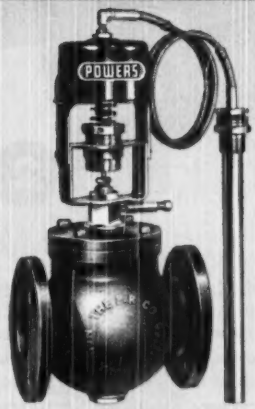
PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories: Los Angeles, California, and Indianapolis, Indiana.
Offices: New York, Atlanta, Chicago, St. Louis, Phoenix, Fresno, Los Angeles; Dallas, Plainview and Lubbock, Texas; Albuquerque, N. M.



Three 6 cyl. 385 HP Diesels at Dominguez Water Co., Los Angeles, Cal.



Regulator may be used in either raw or soft water system. Only one of many applications.



Powers No. 11 Self-Operating Temperature Regulator for jacket water or lube oil control. Available direct or reverse acting, or 3-way valve. Sizes ¼" thru 2" have bronze double union valves; sizes 2½" thru 8" have flanged iron bodies. Pneumatic controls also available.

POWERS

TEMPERATURE CONTROL

End Danger of Cracking Pistons, Cylinder Heads and Sludging, with POWERS Thermostatic Control

Regulate jacket water and lube oil temperatures automatically with POWERS control. Regardless of load or seasonal changes Powers Regulators hold the temperature just where you want it. They prevent *over*heating and *over*cooling.

Accurate Temperature Control—insures better lubrication, longer cylinder liner wear, fewer piston ring replacements, prevents danger of piston seizure, reduces fuel and lube oil consumption.

Powers Control Costs Less than a set of new piston rings. Often pays back its cost the first year. It's economical, reliable, gives many years of dependable service.

Have a Powers Engineer Call to study your requirements for better temperature control. With both *self-operated* and *pneumatic control*s plus many years of experience we may be able to help you select the type that will give best results. There's no obligation. THE POWERS REGULATOR CO., *Established 1891 • Offices in Over 50 Cities • See Your Phone Book.*

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(D-11A)

The Powers Regulator Co., 2771 Greenview Ave., Chicago 14, Illinois

Have engineer call to study our requirements for better jacket water temperature control.

Name of Engine or Compressor ..... HP .....

Your Name .....

Address .....

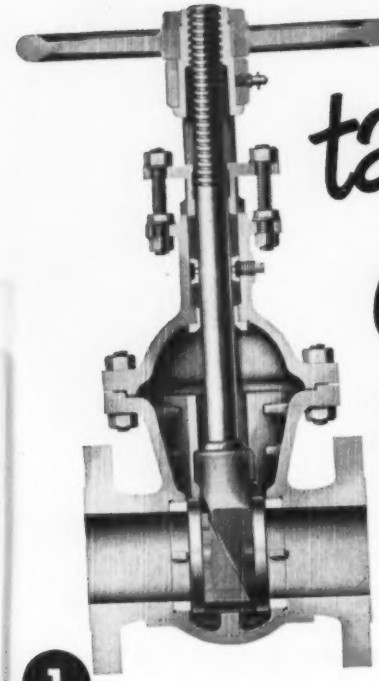
City ..... State .....

PLUS VALUES, JOB-PROVED AGAIN AND AGAIN

DARLING

VALVES

take your choice...



FOR BETTER, LOWER COST SERVICE WITH DARLING cast steel gate valves

DARLING VALVES FOR EVERY NEED

Darling gate valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.

IN addition to gate valves of solid wedge design, Darling offers two other types. Both have distinctive features that prolong valve life while minimizing down time and maintenance. They're great time and money savers! . . .

1 This view shows a Darling gate valve of the fully revolving, double disc, parallel seat type. Time and again users rate it the most trouble-free, best performing gate valve obtainable today. Why? Because its unique design assures: *automatic* adjustment for valve body distortion . . . positive, easy operation . . . uniform wear distribution . . . foolproof simplicity in maintenance and reassembly . . . and service life seldom if ever equalled.

2 Take a close look at the slotted, double-grooved wedge in this cutaway view. There's little wear and tear on *these* wedge faces and seats because the slot permits compression of the wedge to compensate for valve body expansion or contraction due to temperature changes. Moreover, the double grooves, with twin guide ribs in the valve body, provide twice the usual bearing area, eliminating wedge canting and avoiding damage to the downstream seat.

SEND FOR BULLETIN

Why not get *all* the facts on these money-saving valves? Then *you* can analyze and decide whether or not you stand to gain by giving Darlings a try. Simply specify your service requirements . . . or ask for cast steel valve bulletin.

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

TO DO A BETTER PIPING JOB...

USE GLOBE PRECISION PROCESS SEAMLESS WELDING FITTINGS

Your preference for Globe Welding Fittings is supported by a source of supply with exceptional qualifications. Specialized metallurgical experience and facilities gained in years of steel tubing manufacture enable Globe to produce welding fittings by a precision process that yields a superior product.

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GLOBE STEEL TUBES CO., Milwaukee 15, Wisconsin

Chicago — Cleveland — Detroit — New York — Philadelphia — St. Louis — Tulsa — Houston — Denver — San Francisco — Glendale, Calif.

Producers of Globe Seamless Stainless Steel Tubes —Gloweld Welded Stainless Steel Tubes—Carbon — Alloy — Seamless Steel Tubes — Globeiron Seamless High Purity Ingot Iron Tubes and Pipe.

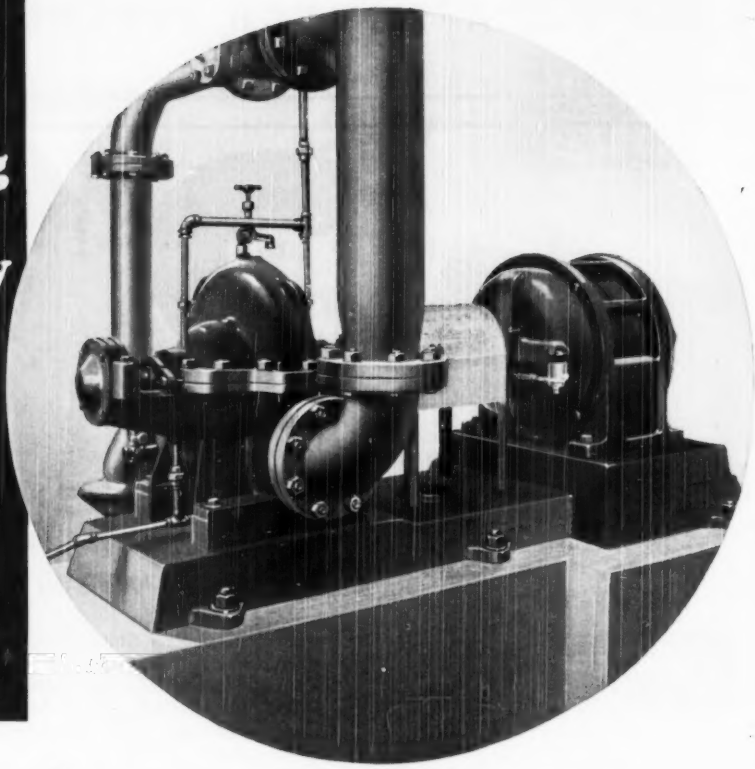
SIZE RANGE OF GLOBE SEAMLESS WELDING FITTINGS

Description of Fitting	Standard Weight (Schedule 40)	Extra Strong (Schedule 80)	(Schedule 160)	Double Extra Strong
Elbows 45° Long Radius	⅛ in. to 24 in.	¾ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Long Radius	⅛ in. to 24 in.	¼ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Returns 180° Long Radius	½ in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	3 in. to 8 in.
Returns 180° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Reducers (Concentric and Eccentric)	1 x ⅜ in. to 24 x 20 in.	1 x ⅜ in. to 24 x 20 in.	1 x ⅜ in. to 12 x 10 in.	1 x ⅜ in. to 12 x 10 in.
Tees Straight	⅜ in. to 24 in.	¾ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Tees Reducing Outlet	⅜ in. to 24 in.	¾ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Stub Ends Lap Joint	1 in. to 24 in.	1 in. to 24 in.	- - -	- - -
Caps	1 in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.

Flanges available 1 inch to 24 inches in all weights

Pumping with Economy

A Midwest Utility Reports:



"Only minor maintenance over 3500 hours service"

Recirculating water at 100°, PH 5.0, this Economy 6″ x 5″ Type M double suction centrifugal pump replaced a conventional pump that did not stand up under the corrosive effect of water laden with tar acids, light oils, fly ash and small amounts of suspended silt. The user of this all-bronze Economy pump, a large mid-west utility, reports satisfactory service . . . minor maintenance.

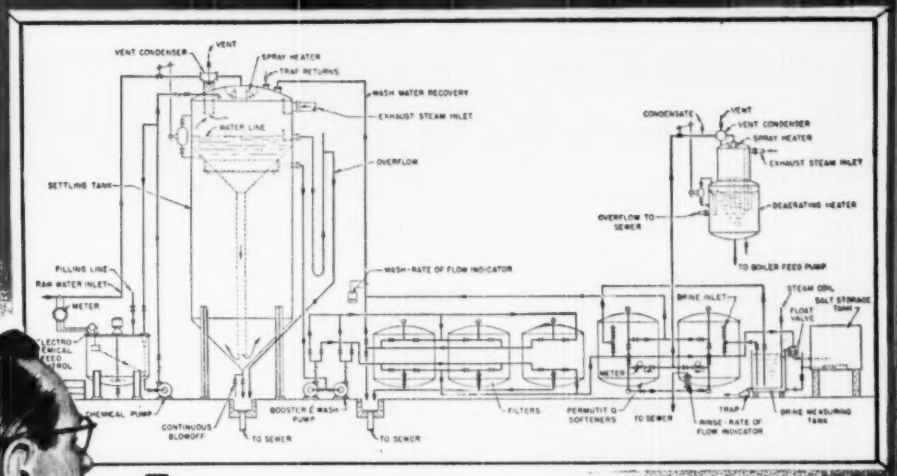
Longer service with less maintenance is typical of Economy Pumps. Many improvements in design, workmanship and materials contribute to their higher efficiency, greater dependability and longer life.

For complete details on Economy Type M double suction pumps, write Dept. BC-11 for Catalog A-1147. For competent engineering advice on any pumping problem, call on your Economy Pump Representative.

Centrifugal, axial, and mixed flow pumps for all applications.

Economy Pumps Inc.

DIVISION OF HAMILTON-THOMAS CORP. HAMILTON, OHIO



"...have you heard about Permutit's New Hot Zeolite Process?

"Permutit announced the process only a few months ago, but already we're putting it to good use in our plant. We think it's the best way of producing water that's low in alkalinity and silica . . . and with all hardness removed."

"Say, Ed, that's really something . . . getting an effluent of zero hardness from a hot lime soda softener! How's it possible?"

"Well, you see, Joe, they've developed a new mineral, Permutit Q. It's an ion exchanger that will withstand boiling water with a pH over 10, and it's not affected under operating conditions like that even after 1300 regeneration cycles."

"Tell me more! Is Permutit Q more economical than phosphate?"

"It is, and what's more, it reduces CO_2 in the steam. I'm really sold on this new process, because our chemical costs are lower, our effluent is lower in alkalinity and total solids, and we don't need acid feeding to prevent deposits in our high stage heaters and economizers."

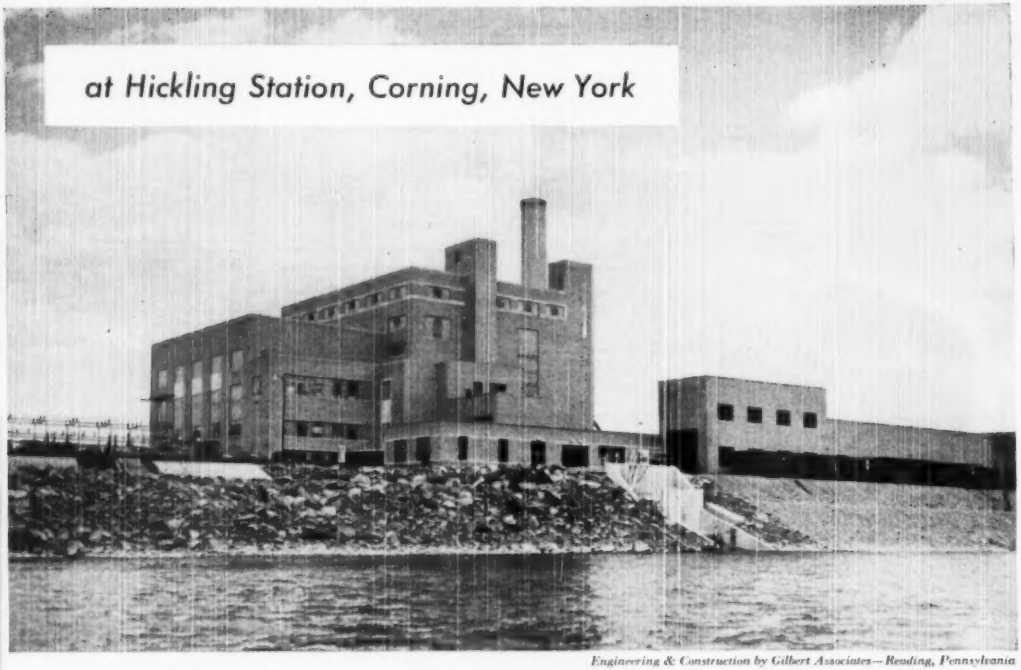
"The more you tell me, Ed, the more I want to know. I think we could put this new hot zeolite process to work in our plant, too. How can I find out full information about it?"

"If you write to Permutit, they'll send you a new bulletin *full* of information. I have their address somewhere . . . oh yes! It's The Permutit Company, Dept. P-11, 330 West 42nd Street, New York 18, N. Y. Then there's the Permutit Company of Canada, Ltd. at 6975 Jeanne Mance Street, Montreal."

"Thanks for the tip, Ed. I'm sending them a letter today!

Water Conditioning Headquarters for Over 37 Years

PERMUTIT



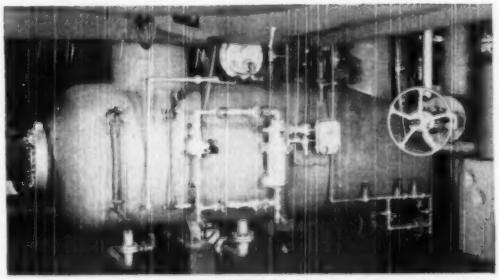
Engineering & Construction by Gilbert Associates—Reading, Pennsylvania

Maximum Solids—0.5 ppm With an ALCO Evaporator

From the fast-moving coal conveyor to the powerful 30,000 kw. generator, every operation is geared for the swift, efficient production of power at the Hickling Station of the New York State Electric & Gas Corporation.

Typical of this efficiency is an ALCO evaporator of new design which performance tests show will produce vapor with maximum solids carryover of 0.5 ppm or less. Such ALCO features as a special vapor scrubber and an exclusive integral deaerating heater insure top performance of this unit. The deaerating section, for example, is fully effective so that ALCO guarantees feedwater leaving this section to have zero free carbon dioxide content and 0.03 cc. of oxygen per liter.

Check these other Alco design features . . . exclusive "flex-tube" action for descaling . . . separate, removable channel and cover . . . patented ALCO compression bolting . . . all add to the efficiency of the evaporator. Write now for more details or call the nearest ALCO Sales Engineer at Chicago, Cleveland, Houston, Kansas City, Los Angeles, New York or Tulsa. Plants at Dunkirk, N. Y. and Beaumont, Texas.



New design ALCO *Evaporator on the job at Hickling Station. Capacity, 7000 pounds of water per hour at 238.3° F. and 24.2 p.s.i.a. when supplied with steam at a pressure of 56.5 p.s.i.a.*

ALCO

ALCO Products Division
AMERICAN LOCOMOTIVE COMPANY

In step with tomorrow—**ALCO AIRCOOLERS, Heat Exchangers, Evaporators, Feedwater Heaters, Pressure Vessels, Pipe**

DO YOU WANT THE FACTS?

ABOUT EFFICIENT INSULATED PIPING SYSTEMS

Every designer and engineer responsible for the insulated piping systems in various industrial, commercial, and residential developments will welcome the complete descriptive technical information found in the series of catalogs and data books recently published on Ric-wiL Prefabricated Insulated Piping Systems.

Publication of these books is in keeping with the Ric-wiL policy established forty years ago of providing not only the finest insulated piping and accessories but also complete technical information for users of Ric-wiL products.

There are five books in the series, each of which deals with specific phases of insulated piping design, engineering, and installation.

Section 480-2—Engineering Data—A comprehensive data book containing pertinent engineering data as applied to insulated piping and steam distribution.

Section 480-3—Typical Engineering Drawing—Consists of a series of typical engineering drawings for insulated piping.

Section 480-4—Insulated Piping Systems Catalog—Contains pertinent general information about Ric-wiL Prefabricated Systems, with many illustrations of the products, their dimensions, installation, and other valuable data.

Section 480-4A—Ric-wiL Tile and Cast Iron Conduit Catalog—Contains complete illustrated and descriptive material dealing specifically with Sectional Tile and Cast Iron conduits, their applications and specifications.

Section 480-5—Specification Data—This book contains specifications for all types of insulated piping and installation procedures.

Copies of any of the described books are available. Write to Dept. 5-X, The Ric-wiL Company, Cleveland, Ohio.

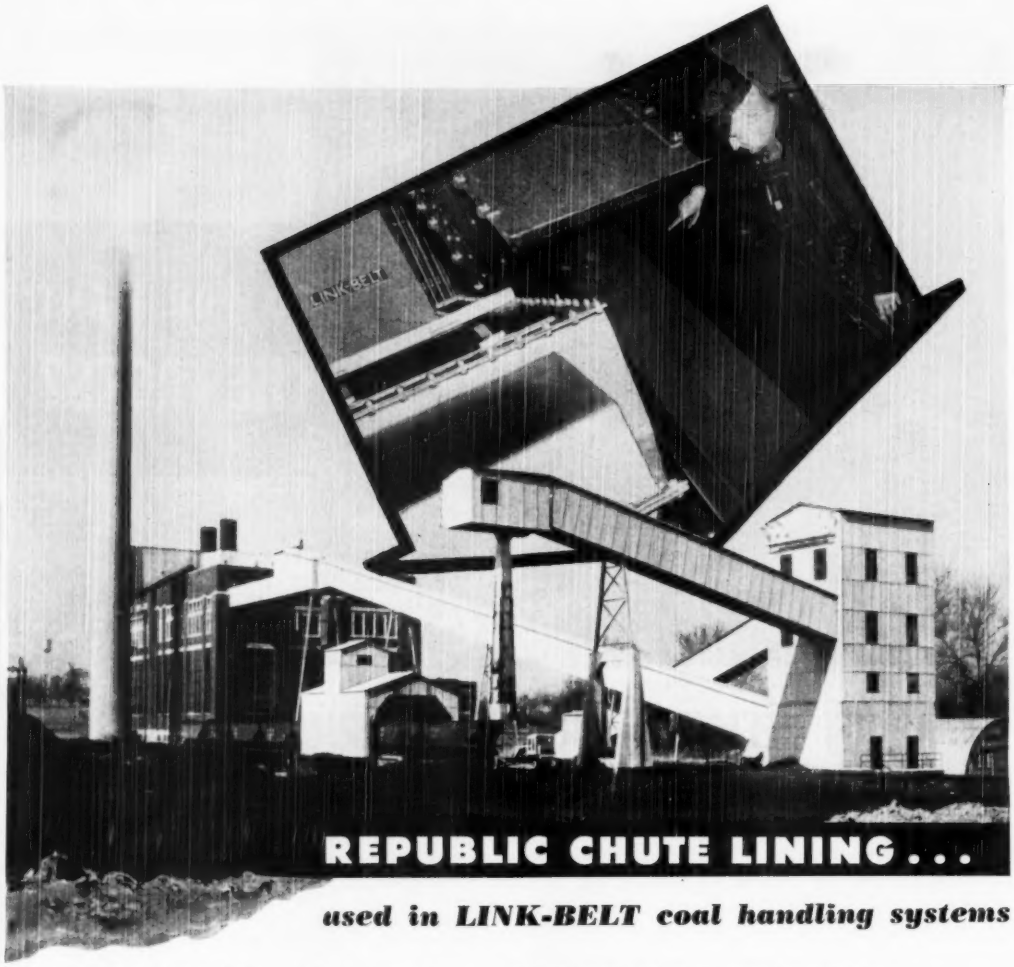
40th YEAR DEPENDABLE INSULATED PIPING SYSTEMS 1910 1950

RIC-WIL

INSULATED PIPING SYSTEMS

OVERHEAD — THE RIC-WIL COMPANY · CLEVELAND, O. — UNDERGROUND

FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS



REPUBLIC CHUTE LINING . . .

used in LINK-BELT coal handling systems

When the Link-Belt Company built a mechanical coal handling system for Ohio Edison's Mad River Generating Station, they lined the metal chutes with Republic Rubber Chute Lining for protection against abrasion and impact. Every day hundreds of tons of coal tumble down the chute shown above.

Republic makes Chute Lining to cushion the impact and to quietly absorb punishment that would otherwise be inflicted upon basic metal structures.

Link-Belt engineers know Republic Chute Lining also discourages hanging and clogging, a condition that results when sticky, wet coal jams against unyielding metal walls. Rubber lining "gives" with pressure to stimulate a steady flow of materials.

Republic Chute Lining increases equipment life by reducing both rust and erosion. Tiny particles of oxidized metal are continually flecking off rusty, unlined chutes. Sooner than you think, replacements will be needed.

This needn't happen if Republic Chute Lining is installed! A true economy product that's easy to install and easy to replace, Republic's Chute and Launder Lining is available in both plain and fabric-backed construction to suit your particular requirements.

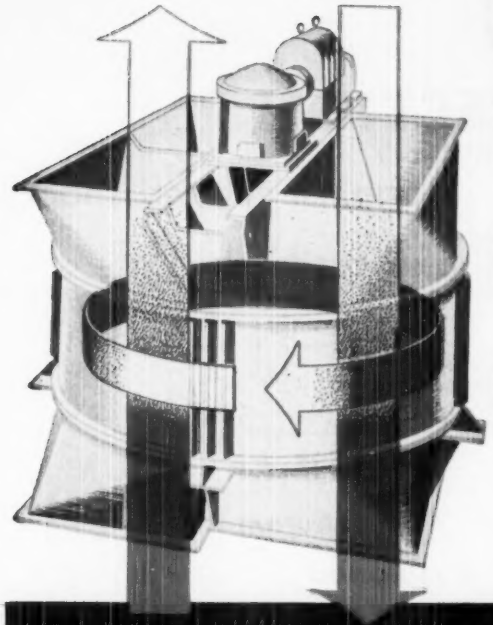
Get in touch with your local Republic Distributor now or write direct for a free analysis of your needs. Remember, Republic Rubber has been *the* industrial rubber specialist for nearly a half century.

INDUSTRIAL RUBBER PRODUCTS BY

REPUBLIC RUBBER DIVISION

Lee Rubber & Tire Corporation

YOUNGSTOWN, OHIO



this preheater is cutting fuel costs in hundreds of plants

the *Ljungstrom* AIR PREHEATER

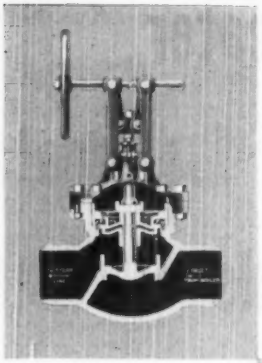
The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves the heat is transferred from the waste gases to the incoming cold air.

The Ljungstrom air preheater has proved its value in industrial and utility plants throughout the country. That is why every year a constantly increasing percentage of the installed boiler capacity is equipped with Ljungstrom air preheaters.

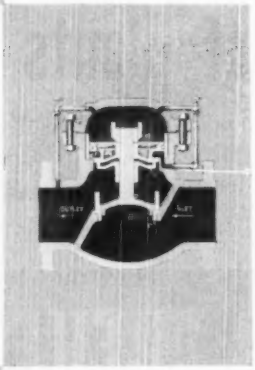
Your fuel costs will be lower too, when your boiler is equipped with the Ljungstrom air preheater. The regenerative design of the Ljungstrom permits reliable operation at low exit gas temperatures. This assures the greatest possible heat recovery . . . reduces the amount of fuel required.

If you are planning a new installation, or expanding your present one, our engineers will welcome the opportunity to show you how the Ljungstrom can raise the overall efficiency of *your* plant.

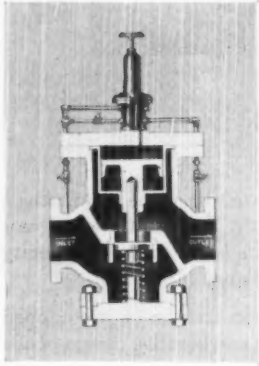
THE AIR PREHEATER
60 East 42nd Street, New York 17, N. Y.
CORPORATION



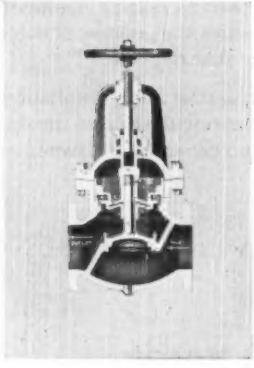
G-A double-cushioned single-acting non-return valve, toggle yoke assembly, globe pattern.



G-A double-cushioned check valve, globe pattern.



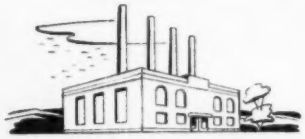
G-A cushioned unloading valve, globe pattern.



G-A combined throttle and automatic engine stop valve, globe pattern.

Your best **PROTECTION**

against sudden shock, "hammer" and costly damage



GOLDEN-ANDERSON

Automatic

Cushioned *Steam plant*

VALVES

Golden-Anderson Valves have proven efficiency, quality and dependability for over 35 years in the tough applications put to them by America's industrial and power plants. The cushioning arrangement in all G-A valves permits them to operate smoothly at all times.

Golden-Anderson designs and builds over 1500 types and sizes of valves for engineered protection and high pressure installations. Let our experienced engineers help you on your next valve problem.

GOLDEN-ANDERSON *Valve* SPECIALTY COMPANY

2070 Keenan Building · Pittsburgh 22, Pa.

GA

LIFE AND PROPERTY PROTECTION

VALVES

FOR OVER 50 YEARS

"Why am I an Orphan?"

...said the small-boiler operator

He was in a pretty tough spot. *Sure,* he wanted to collect his fly ash. But how could he afford a custom-engineered fly ash collector for a boiler under 2000 BHP? He *hated* to think of installing *anything* short of a real fly ash collector!

Could we help? Simple... just tell him about the new Buell 'LR' (Low Resistance) Fly Ash Collector!

SPECIALLY DESIGNED FOR SMALL BOILERS

The cost of the 'LR' Fly Ash Collector fits the smaller plant's budget nicely. Yet the 'LR' is guaranteed to collect 99% of all 100-mesh cinder discharge. And the draft loss is so low you can even use the 'LR' on a *natural draft* boiler!

Practical? The 'LR' is chunky, compact... made to fit a small plant's boiler room. And there's no cleaning, no water, and no maintenance except emptying the hopper!

If you run a coal-fired boiler between 100 and 2000 BHP, write for complete facts on Buell's new 'LR' Fly Ash Collector. Buell Engineering Company, Suite 5045, 70 Pine St., New York 5, N. Y.

buell

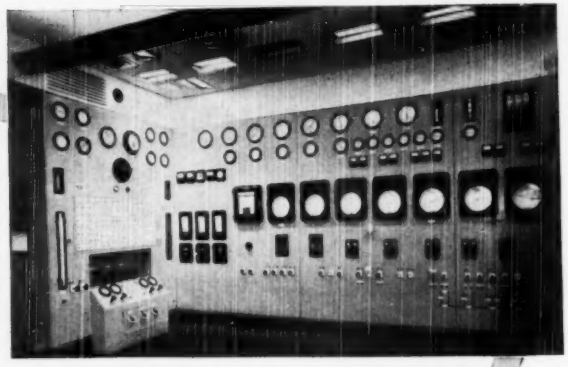
Engineered Efficiency in

Fly Ash Collection

'LR' for small boilers

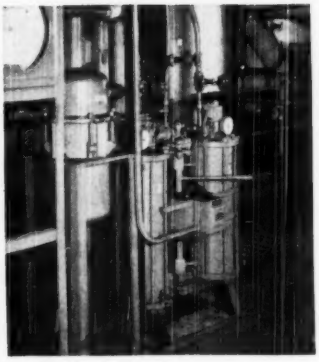
WE'LL BE AT **BOOTH 72**
AT THE POWER SHOW
Grand Central Palace
New York City...
NOV. 27 to
DEC. 2

Between the instrument board



and the draft fan controllers

this *Lectrodryer*



No freeze-ups! Air lines are kept DRY by this Lectrodryer

Draft fans are on the roof at the Essex Generating Station of Public Service Electric & Gas Company, Newark, New Jersey. Dampers are air-operated. That meant trouble in freezing weather, so housings containing strip-heaters were built around the controllers. But still they froze up.

This Lectrodryer, installed to DRY the air fed to lines going out-of-doors, cured the trouble.

DRYing compressed air is an old story for Lectrodryers—instrument air in petroleum refineries and chemical processing plants, air fed to tools and other functions. No long delays for water to drain out when valves are opened. No clogging of delicate ports or freezing of lines. Lectrodryers save time and money.

Send for questionnaire so that we may figure with you on your instrument-air drier needs. You will be interested, also, in Bulletin 216 which shows how other companies have profited by using Lectrodryers. Write Pittsburgh Lectrodryer Corporation, 329 32nd Street, Pittsburgh 30, Pennsylvania.

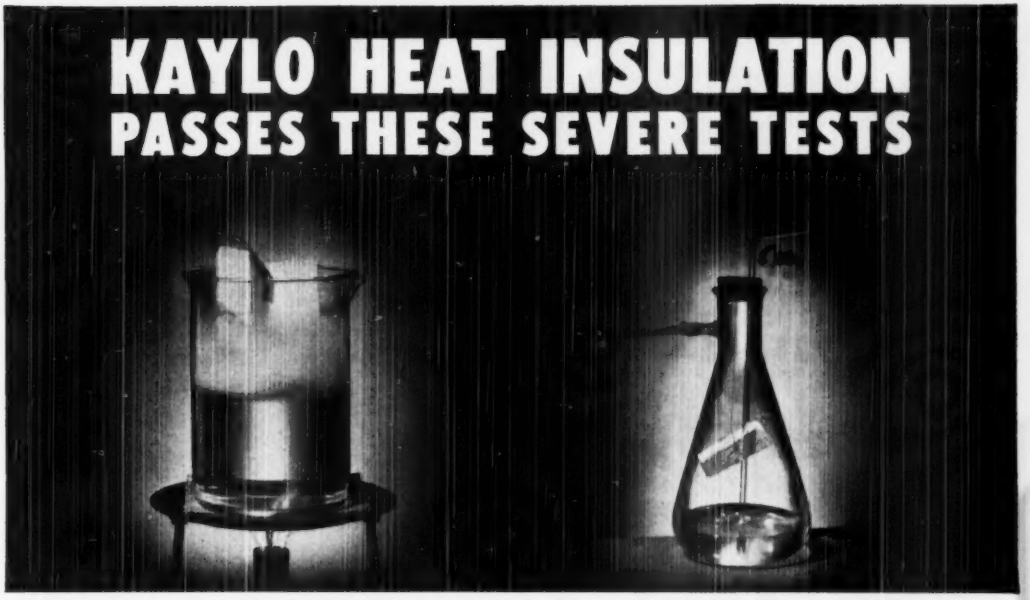
In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In Australia: Birlec, Limited, 51 Parramatta Road, Glebe, Sidney.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

REGISTERED TRADEMARK U. S. PAT. OFF.

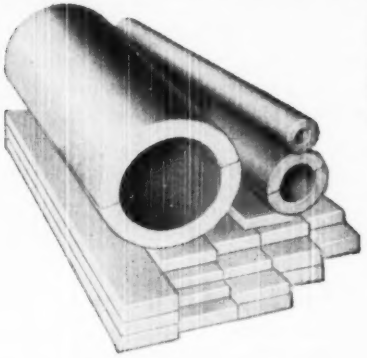
KAYLO HEAT INSULATION PASSES THESE SEVERE TESTS



BOILING TEST: Samples of Kaylo Heat Insulation have been boiled continuously for 24 hours and longer. None disintegrated or showed any loss of insulating efficiency after drying.

FUME TEST: Samples of Kaylo Heat Insulation were suspended in an aerated mixture of water vapor and SO_2. The Kaylo samples showed no deterioration after weeks of direct exposure.

One Material Insulates Efficiently up to 1200°F.



Kaylo Heat Insulation is made of hydrous calcium silicate (not glass), a remarkable material with high insulating efficiency up to 1200°F. This new type of inorganic insulating material retains its stability in long service under severe conditions. Exceptional strength and lighter weight make it easier to handle and apply.

KAYLO PIPE INSULATION is produced in Simplified Dimensional Standards of thicknesses and diameters for pipe sizes from ½" to 72". Coverings are sectional for sizes ½" to 12"; tri-segmental for 8" to 23"; quad-segmental for 19" to 41"; K-segmental (18" sections) for 38" to 72". O.D.'s of insulation correspond to O.D.'s of standard pipes.

KAYLO HEAT INSULATING BLOCK is available for single layer application in thicknesses from 1" to 6". It is made in all standard sizes up to 18" x 36".

KAYLO®

PIPE INSULATION AND HEAT INSULATING BLOCK

OWENS-ILLINOIS GLASS COMPANY
Kaylo Division • Toledo 1, Ohio

SALES OFFICES:
Atlanta · Boston · Buffalo · Chicago · Cincinnati · Houston · Minneapolis · New York
Oklahoma City · Philadelphia · Pittsburgh · St. Louis · Toledo · Washington

SEND COUPON FOR KAYLO HEAT INSULATION LITERATURE

OWENS-ILLINOIS GLASS COMPANY
Dept. N-75, Kaylo Division • Toledo 1, Ohio

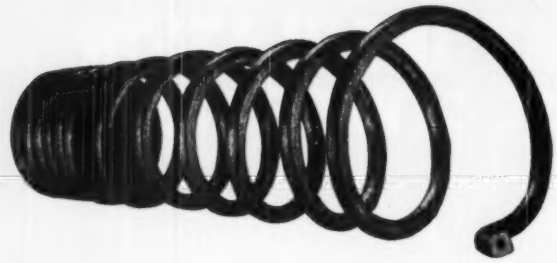
Gentlemen: Please send me descriptive literature on Kaylo Heat Insulation.

NAME.....

FIRM.....

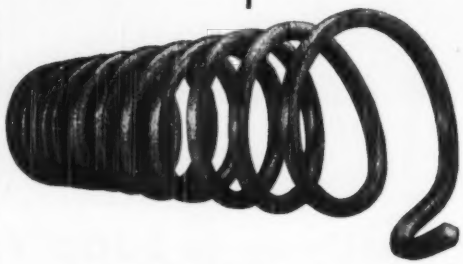
ADDRESS.....

CITY.....STATE.....



R/M No. 121 | 2 high-pressure packings especially built for tough jobs

R/M No. 122



Raybestos-Manhattan manufactures a variety of packings especially designed for compressors, steam pumps, steam valves, expansion joints and other high-pressure equipment.

R/M No. 121 is constructed of asbestos cloth over a resilient core of asbestos and rubber. It is commonly used on steam engines, compressors and pumps. It is also available in a solid form (No. 124).

R/M No. 122 is made of a resilient rubber core covered with bias-cut asbestos cloth lubricated and graphited. It is recommended for reciprocating steam or air rods and valve stems. For extra-heavy service, this packing can be furnished reinforced with wire-inserted cloth.

For full information on R/M packings for high pressure equipment, see the authorized R/M packing distributor near you, or send in the coupon below.

RAYBESTOS-MANHATTAN, INC.

PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn. Manheim, Pa. No. Charleston, S.C. Passaic, N.J.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Mechanical Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts Radiator Hose • Powdered Metal Products • Bowling Balls

RAYBESTOS-MANHATTAN, INC. P-110
Packing Division, Manheim, Pa.

Gentlemen: Please send me data on R/M high-pressure packings.

Name_____

Position_____

Company_____

Address_____

City_____ Zone_____ State_____

R M

1500 Pounds at 1000°F.

Vogt

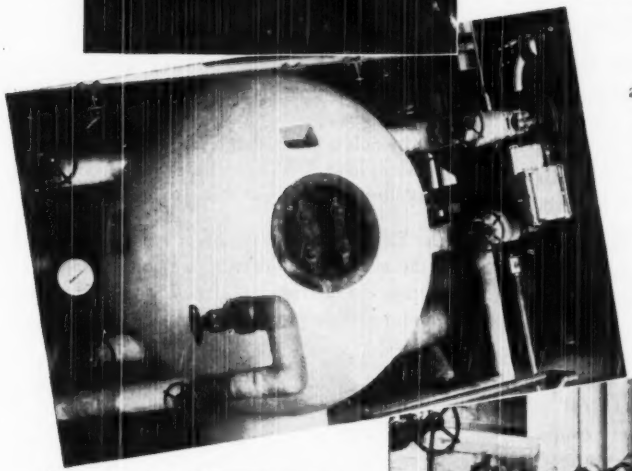
DROP FORGED STEEL

CHROME-MOLY STEAM VALVES

Hold the line at...

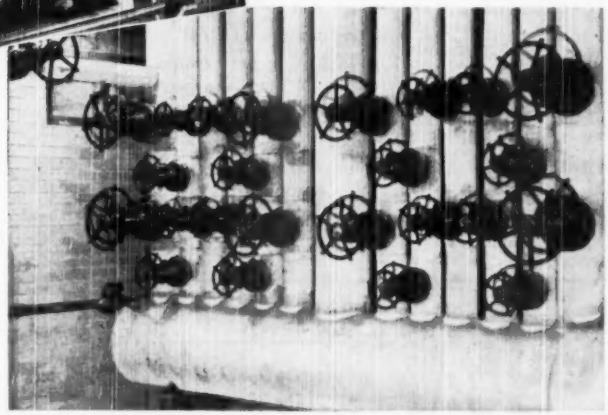
Oswego, N. Y. Station of

* NIAGARA MOHAWK POWER CO.



Leading central stations know and trust Vogt drop forged steel chrome-moly valves in their toughest high pressure and high temperature services. Specify Vogt . . . and be SURE!

**The Huntley Station at Buffalo and Dunkirk Station at Dunkirk, N. Y. use many Vogt valves.*



TOP: Air view of Oswego, N. Y. Station of Niagara Mohawk Power Co.

CENTER: Valves on main drum of 875,000 pounds per hour steam generator.

RIGHT: Drains from main steam, attemperator, and superheater lines employ a maze of valves.

NEW CATALOG F-9

Consult its 400 pages for the complete Vogt line of drop forged steel Valves, Fittings and Flanges for steam, water, oil, gas, air and refrigeration services.

HENRY VOGT MACHINE CO., Louisville 10, Kentucky

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

Which Shall It Be?

UNDERFEED *or* SPREADER

ERIE City Underfeeds may be used under boilers from 100 to 700 developed horsepower, depending on the load characteristics of the plant and the fuel available. Underfeeds are recommended if the load is under 25,000 pounds of steam per hour and one involving low night demand or 100% heating.

An important advantage of the underfeed is its ability to operate under banked fire conditions for indefinite periods, requiring only the part time attention of the fireman, freeing him for other duties.

Coal should not exceed 2" size and this size held to about 10%. A random mixture of 3/4" x 1 1/4" is ideal. Slack coal up to 25% is permissible but too much slack may cause feed or distribution problems. Write for bulletin SB-27.

ERIE City Spreader Stokers are recommended for boilers above 150 nominal horsepower. Spreaders, because they burn coal in suspension, and require only a thin fuel bed, are highly responsive to fluctuating load demands. Spreaders are not well suited for very low loads or banked fire operation.

The Erie City dumping grate spreader is ideal where the minimum load carried is high enough to assure covering the fuel bed with a layer of fuel and maintaining sufficiently high temperature for proper combustion.

The outstanding advantage of the spreader stoker is its ability to handle efficiently widely varying low quality coals. This economic advantage may offset the difficulty of carrying low loads at certain periods. Write for Bulletin SB-31.

Erie City engineers will gladly study your firing problem and make recommendations.

COMPLETE STEAM POWER PLANT EQUIPMENT

ERIE CITY

Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*

"For high dust collection efficiency CONSIDER THESE FACTS!"

95% to 99% REMOVAL

Your specific needs determine the exact percentage of fly ash removed by a Research Corporation Cottrell Precipitator.

LOW DRAFT LOSS

The pressure drop between inlet and outlet of the Cottrell is extremely low, averaging *only a few tenths of an inch of water.*

DURABILITY

Low velocities hold abrasion to a minimum.

ANY CAPACITY

Cottrell precipitators have been used successfully with both small boilers and the very large boilers developed in recent years.

OTHER APPLICATIONS

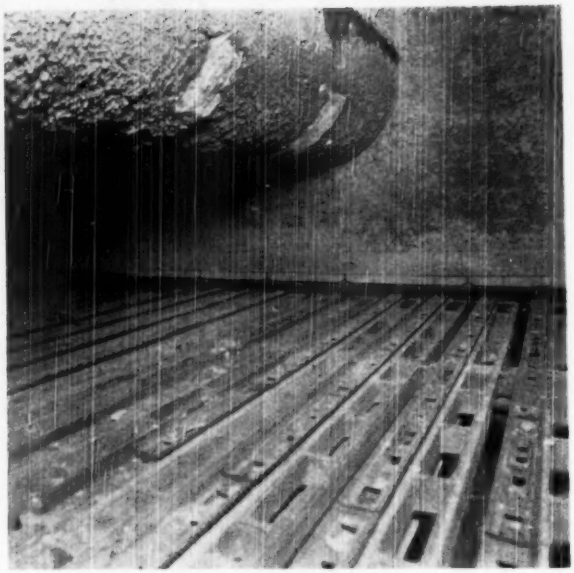
Cottrell precipitators have wide application in the recovery of other materials such as acid mist, blast furnace dust, sodium salts, fluid catalyst and valuable metals from smelters.

YOU GET all these important advantages PLUS Research Corporation's 38 years of experience in the field of electrical precipitation. Every Cottrell installation is individually engineered to do the most efficient job. For more facts about Research-installed Cottrells, send for Bulletin 500.

RESEARCH CORPORATION

405 Lexington Avenue, New York 17, N. Y.
122 South Michigan Avenue, Chicago 3, Illinois

HOW TO AVOID THE 3 COMMON CAUSES OF BOILER WALL FAILURE



LOWER MAINTENANCE COSTS in boiler furnaces result from Norton Crystolon* (silicon carbide) brick at the clinker line, thanks to their high refractoriness, resistance to slag penetration and to abrasion.

If high heat, slag penetration and abrasion at the clinker line are causing you frequent shutdowns and excessive maintenance costs, it's time to investigate Norton Crystolon (silicon carbide) shapes . . . hollow air-cooled blocks or solid bricks.

Proved Properties

1. Norton Crystolon shapes are highly refractory . . . successfully resist temperatures up to 3100°F.

2. Made in very dense form with a maximum percentage of silicon carbide, they effectively resist slag penetration. In rare cases when clinkers do adhere, you can easily remove them without damage to the refractory.

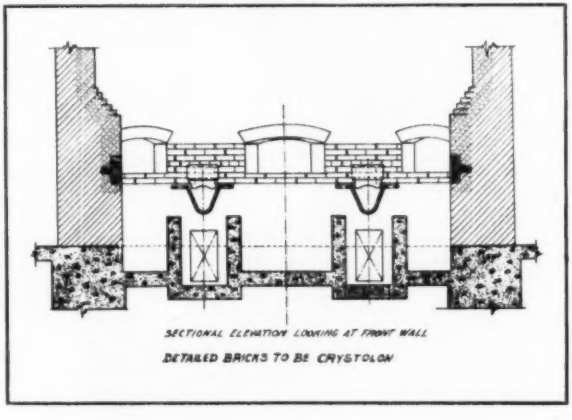
3. Since silicon carbide is a tough abrasive, Norton Crystolon blocks and bricks are not noticeably affected by the abrasion of the moving fire bed of stoker-fired furnaces.

All Shapes

Norton Crystolon air-cooled blocks and solid bricks, with mating tongues and grooves for easy installation, come in any size and shape your furnaces call for. Norton Type A (rectangular), Type B (T-shaped) and Type C (U-shaped) blocks and bricks are also available for replacement purposes.

Get All The Facts

For more complete information about Norton Crystolon silicon carbide shapes, consult your nearby Norton representative, or write direct for Bulletin 862. NORTON COMPANY, 601 New Bond Street, Worcester 6, Mass.



NORTON CRYSTOLON BRICKS, as detailed in this front wall elevation, quickly pay for themselves where spalled, eroded or cracked refractories previously have caused frequent shutdowns.

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

Special REFRACTORIES

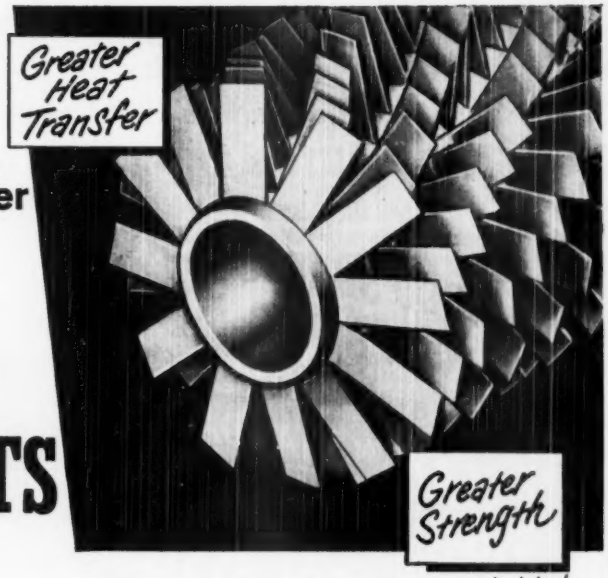
Canadian Representative

A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

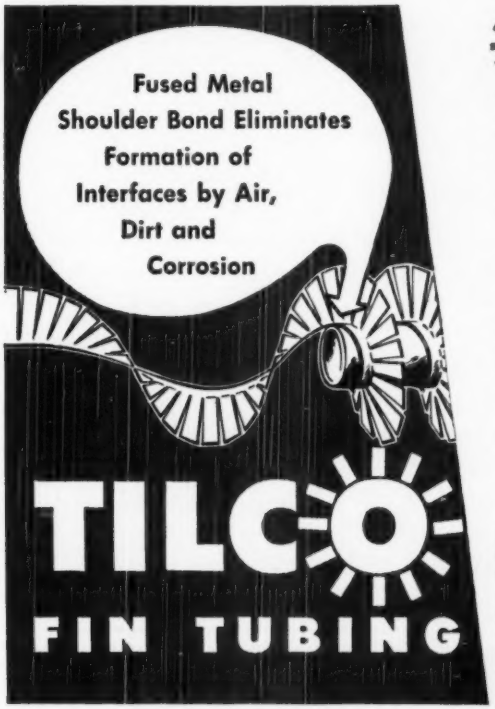
NOW!

Exclusive Fin-Shoulder Bonding

LOWERS STEAM COSTS



Only TILCO Strip Fin Tubing is SHOULDER BONDED by Welding



TILCO-FIN DIVISION
David E. Kennedy, Inc., Brooklyn, N. Y.

Fin tubing is the modern way to cut high steam costs. But now Tilco exclusive features can make your steam costs drop *even more.*

Here is why: Tilco is the only strip fin tubing *shoulder bonded* by resistance welding, soldering or brazing. Its full ⅛" shoulder makes possible (1) a fused metallic bond that eliminates 3 big causes of heat transfer loss…the formation of interfaces by air, dirt and corrosion, and (2) it imparts such increased strength to the fin bond that it will not break under any conceivable service condition.

Flexible Application

Tilco's own specially designed manufacturing equipment provides flexibility that can give you a "tailor made" installation. Wide range of metals…steel fin welded to steel tube …stainless steel fin welded to stainless steel tube…steel fin welded to cupro-nickel tube and many others. Fin spacing from 2 to 16 fins per inch…fin heights from ⅛" to 2"…tube diameters from ½" to 6".

Mail the coupon today for a free sample or to have a representative call. You will learn why fin tubing reaches the most advanced point of effectiveness in "Shoulder Bonded" Tilco-Fin Tubing.

TILCO-FIN DIVISION, David E. Kennedy, Inc. Dept. H
58 Second Avenue, Brooklyn 15, N. Y.

I want to know more about "Shoulder Bonded" Tilco-Fin Tubing and how it will lower steam cost more than ordinary fin tubing. I understand there is no obligation.

1. *Have a representative call* ☐
2. *Send me a free sample* ☐ Please Check

NAME_____

FIRM NAME_____

BUSINESS ADDRESS_____

CITY_____ STATE_____

GET A GOOD SHARE OF SAVINGS FROM YOUR BOILER ROOM . . . .

TO OFFSET *Higher Production Costs*

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

Install a CASH STANDARD Automatic Combustion Control System and you get the following results. The rate of fuel feed is adjusted exactly to the load requirements at all times—a correct proportion of carbon from the fuel and oxygen from the air is maintained—you avoid heat waste thru the stack because of proper operation of the stack damper.

Your present boiler becomes a better producer of steam. Your fuels work with peak effectiveness so that you use less fuel for the steam you require. Your maintenance needs are greatly lessened. You get continuous, dependable, accurate automatic control at all times.

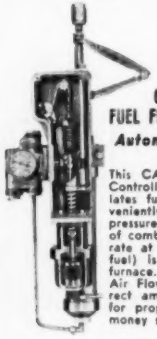
When you have CASH STANDARD Correct Fuel Feed . . . Fuel-Air Ratio and Over-Fire Draft, you make savings that help level off high production costs.

BOOKLET No. 300 gives details on steam plant economy

This booklet describes and shows various installations of CASH STANDARD units on coal, oil, and gas burning boilers. Each unit is pictured and explained in detail. Send for your copy and see why you can effectively use this CASH STANDARD Automatic Combustion Control System to save money.

SYSTEMS FOR ONE OR A BATTERY OF BOILERS

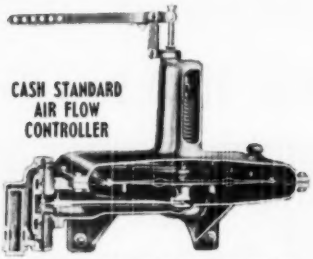
● **CASH STANDARD** units are available in a number of variations. Combinations can be made to give you complete automatic control with all of its benefits. Size of your boiler or type makes no difference.



CASH STANDARD FUEL FEED CONTROLLER . . .

Automatically Regulates Fuel Feed

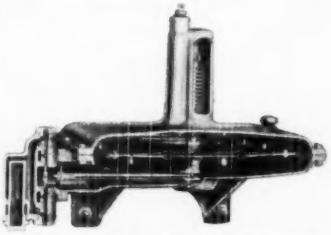
This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.



CASH STANDARD AIR FLOW CONTROLLER

Meters the Air Needed for Combustion

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



CASH STANDARD FURNACE DRAFT CONTROLLER

Maintains a Constant Draft in the Combustion Chamber

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

Reduce Engine Exhaust and Compressor Intake Noise—with

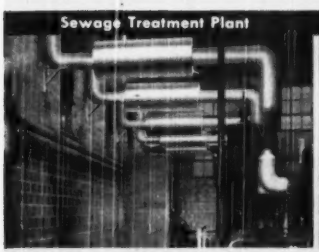
BURGESS-MANNING SNUBBERS

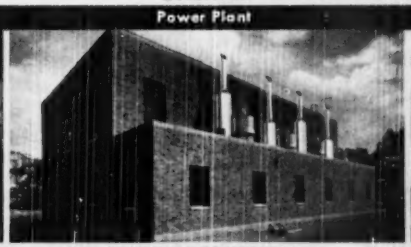
In every field of industrial activity . . . utility, manufacturing, petroleum . . . where noise from engines or compressors, gas surging in pipe lines, or harmful engine or compressor vibration cannot be tolerated, you will find Burgess-Manning Snubbers. Snubbers prevent noise by smoothing the flow of intake air and dissipating the energy in the exhaust gas slugs, providing quiet operation without affecting performance. Consult the Burgess-Manning engineers for a solution to your noise problems.

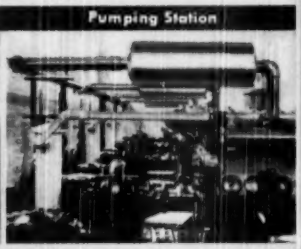
BURGESS-MANNING COMPANY
LIBERTYVILLE, ILLINOIS

SDG Slug Buster Snubber

UTILITIES

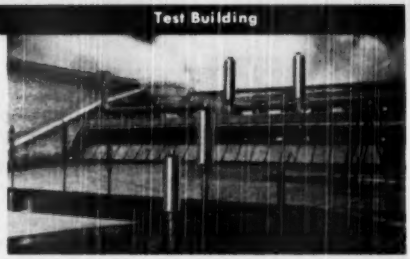




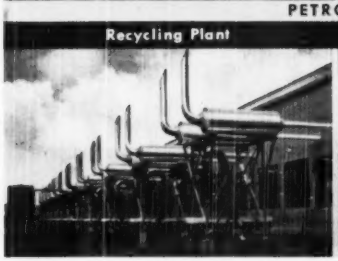


MANUFACTURING

SNUB THE SLUG AND STOP THE NOISE



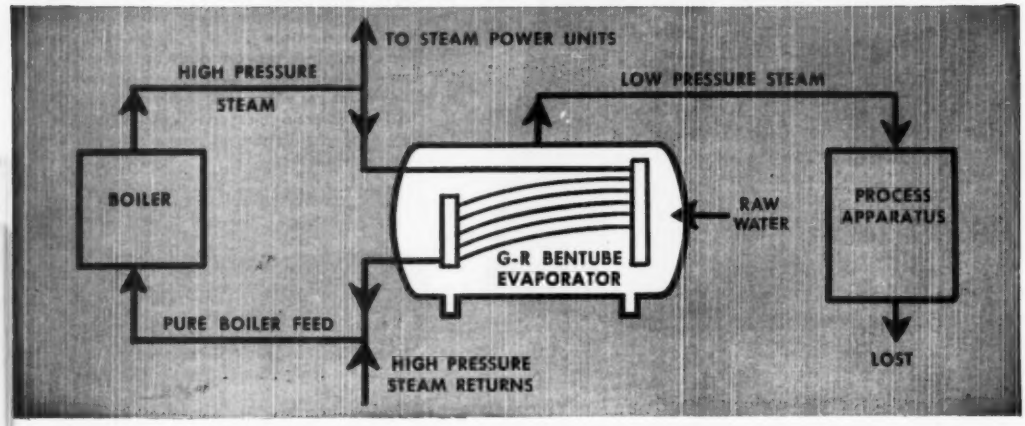
PETROLEUM



For Quiet Telephoning . . . Burgess-Manning ACOUSTI-BOOTH

Thick walls of sound-absorbing material soak up noise. You can hear easily . . . talk comfortably in noisy surroundings. Suited to any location. Modern appearance. Wall and floor models. Doorless. Airy. Compact.

HOW you can obtain PROCESS STEAM efficiently



Bulletin 366 explains the various methods of associating evaporators with the plant heat balance and describes in detail the designs and special features of G-R Evaporators. Write for your copy.

A G-R Bentube Evaporator uses steam from high pressure sources to produce lower pressure steam for process work. The high pressure steam which operates the evaporator is all returned to the boiler, after use, in the form of condensate. Therefore, no raw, scale-forming make-up or contaminated drains from steam used in process is fed to the boiler, thus reducing boiler maintenance.

Raw untreated water can be fed to the evaporator producing the process steam. G-R Bentube elements of scale-shedding design make possible the use of raw water because they maintain rated heat transfer without requiring hand scaling.

The G-R Bentube Evaporator used in this service operates as a practically 100% thermally efficient reducing valve, and ideal plant heat balance can be arranged.

Many millions of pounds per hour of process steam are now being produced in highly successful G-R Bentube Reducing Valve Evaporator plants. Investigate this economical method of obtaining process steam for your plant.

THE GRISCOM-RUSSELL CO.
285 MADISON AVENUE, NEW YORK 17, N. Y.

GR-196

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

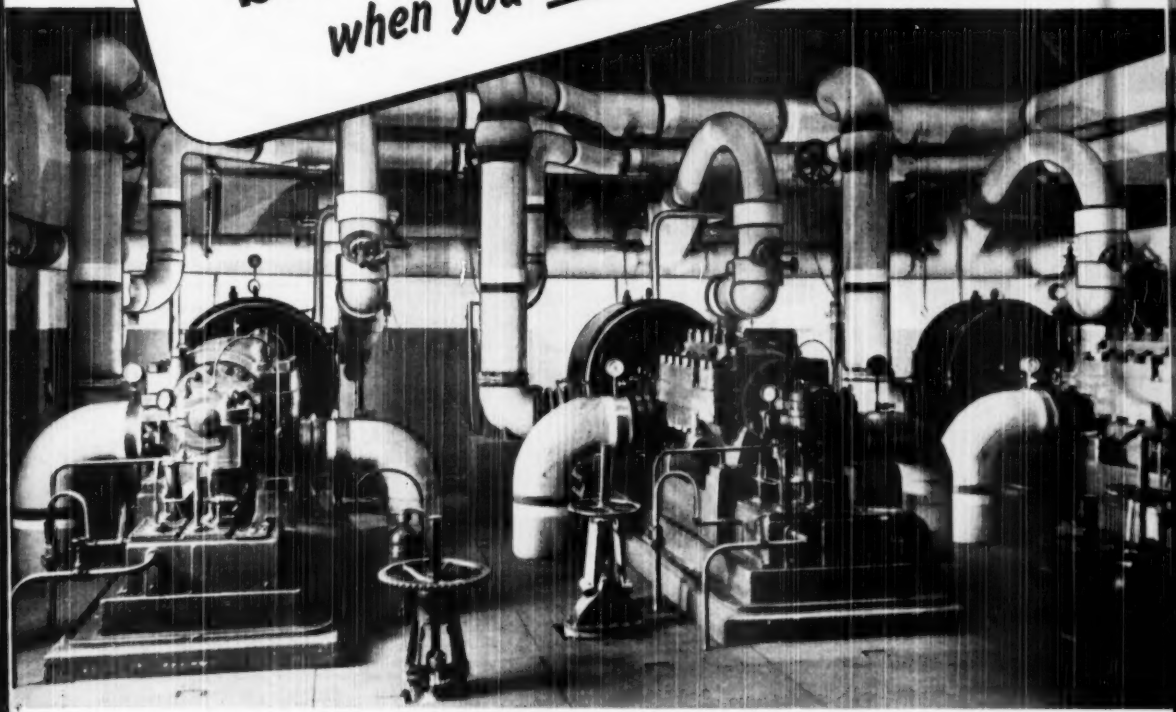
BLAW-KNOX is well aware that piping requires the knowledge of the engineer and the designer as well as the skill and experience of the fabricator. Everything must be considered—pressure, temperature changes, chemical conditions, metallurgical problems, exact fit and ease of installation at the site.

That is why Power Piping Division is so often selected to do critical jobs. It has the facilities, the staffs, the shops, the equipment, the engineering and designing knowledge to handle any size piping job quickly, authoritatively, economically. And the results speak for themselves over the years.

When the project calls for Power Piping, consult . . .

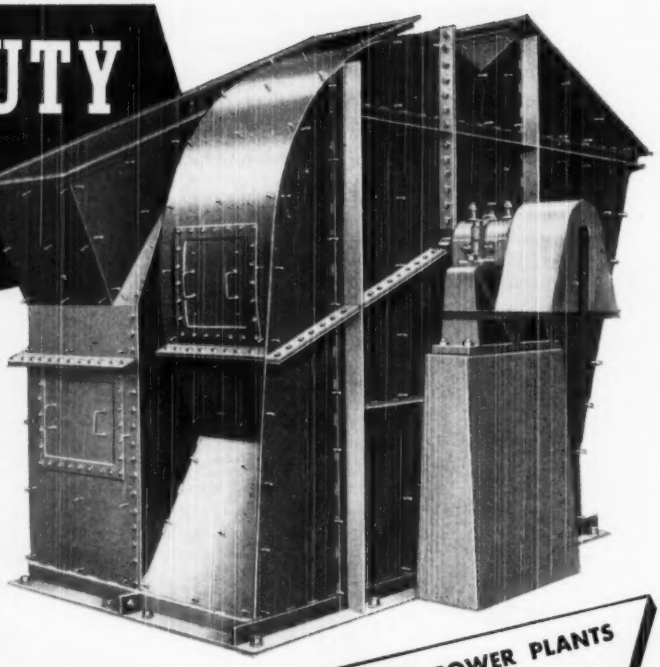
POWER PIPING DIVISION
OF BLAW-KNOX CONSTRUCTION COMPANY
1525 Pennsylvania Ave., N.S., Pittsburgh, Pa.

SIMPLE...
when you *know* how!



BLAW-KNOX *Power Piping*

HEAVY-DUTY
for *Important*
FAN JOBS

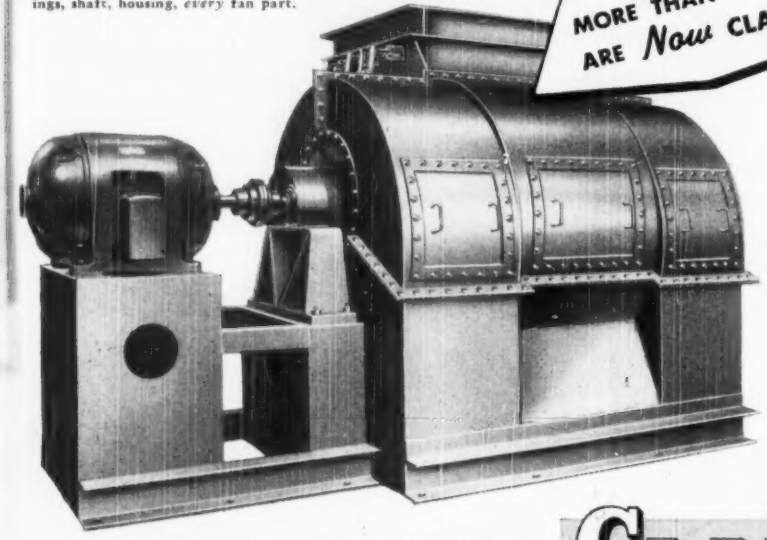


This ad shows Clarage Type RT Fans, especially designed and built for *tough* air handling services — large volumes (up to 300,000 c.f.m.), high static pressures, high temperature applications.

Induced draft is one of the services to which this Clarage equipment is *particularly* adapted. The Type RT Fan at right is arranged for induced draft fan work. It is equipped with inlet box, insulation clips and water-cooled bearings which permit the handling of extremely high temperature gases with long-lasting performance.

Type RT Fan construction is HEAVY-DUTY — and that applies to wheel, bearings, shaft, housing, *every* fan part.

MORE THAN 3000 POWER PLANTS ARE *Now* CLARAGE EQUIPPED



The Type RT Fan at left is equipped with *fan*-cooled bearings. For medium high temperature work (industrial process air handling and some types of induced draft), *fan*-cooled bearings — *a Clarage development* — are practical and *less expensive* than water-cooled bearings.

All Type RT Fans operate at speeds suitable for direct drive from electric motors or steam turbines.

DIRECT YOUR INQUIRY INTO CAPABLE HANDS

Clarage equipment — from the smallest to largest fans — is built HEAVY-DUTY. Whatever your air-handling problems, we can provide satisfactory results at astonishingly low operating and maintenance costs. *Your inquiry is invited.*

CLARAGE FAN COMPANY
KALAMAZOO, MICHIGAN
Sales Engineering Offices in All Principal Cities

CLARAGE
—HEADQUARTERS for Air Handling and Conditioning Equipment

THESE commanding buildings house expanded facilities and utilities of a prominent manufacturer of heat insulating materials. They express the new vigor and growth of this concern which has now compressed a slow four-day process into the remarkably short time of only eighteen hours.

Such an achievement is a tribute to the engineering skill and ingenuity of the highly trained experts who accomplished this feat.

The Kuljian System of *unified engineering and construction responsibility* has again justified its outstandingly successful reputation in constructing this new plant which improves the product and increases profits for the owners. And—equally important—Kuljian has maintained design and construction schedules and completed this project in less time and at less cost than has been true of similar contemporary projects.

KULJIAN

ST. PETERSBURG, FLA.
WASHINGTON, D. C.
ROME, ITALY
CALCUTTA, INDIA
CARACAS, VENEZUELA
MEXICO CITY, MEXICO

The **Kuljian** *Corporation*

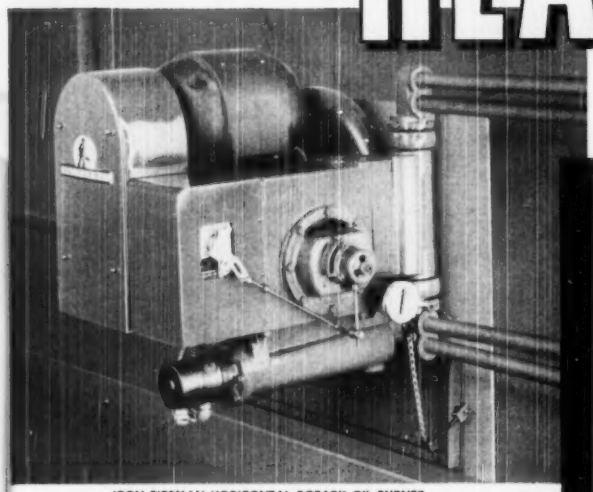
ENGINEERS • CONSTRUCTORS

1200 NORTH BROAD STREET, PHILADELPHIA 21, PA.

IRON FIREMAN

precision firing with HEAVY OIL

NO. 6 OR LIGHTER



IRON FIREMAN HORIZONTAL ROTARY OIL BURNER

Oil feed rate stays within ½ of 1% of setting, regardless of oil temperature or viscosity

America's most advanced burner for firing heavy fuel oil

The Iron Fireman horizontal rotary oil burner completely eliminates the troublesome viscosity factor in firing heavy oils. Oil-flow to nozzle is steady and uniform, metered with extreme accuracy by the Iron Fireman Oil Volumeter which is wholly unaffected by viscosity changes.

This makes possible the highest degree of precision in flame control attained in heavy oil firing. Perfect synchronization of oil and air volume produces efficient combustion, even when throttled down to 10 per cent of capacity.

Every detail of this superb burner has been engineered with extreme care. Oil and air passages have been carefully designed to assure efficient operation with low power consumption.

For further information write to Iron Fireman Mfg. Co., 3237 W. 106th St., Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada. Qualified dealers throughout the U. S. and Canada.

IRON FIREMAN OIL VOLUMETER

The Iron Fireman Oil Volumeter is a positive displacement, variable volume metering pump, completely submerged in the oil reservoir. It meters oil to the nozzle by regulating the stroke of its multiple pistons. No regulating valves or viscosity compensating device is required.

SYNCHRONIZED OIL-AIR CONTROL

Single control lever regulates oil, primary and secondary air. Correct fuel-air ratio maintained automatically through entire firing range. For manual, semi-automatic or full automatic operation.

FOUR-PORT HINGE POST

Permits installation of hot water or steam oil heater in oil line on *pressure* side of burner pump. No suction pumping of hot oil to form vapor locks.

OIL-GAS-COAL COMBINATION

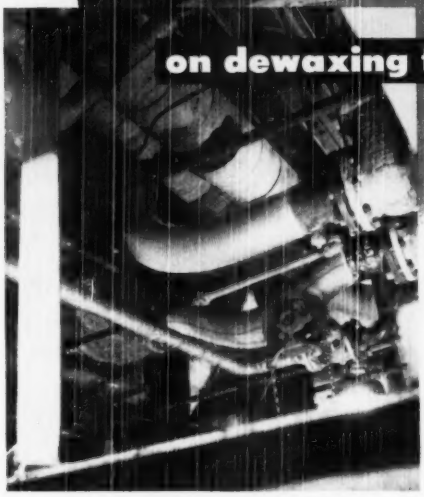
Iron Fireman ring-type gas burner and pneumatic spreader stoker combine perfectly with rotary oil burner. Fuel change is accomplished in a short time without major alterations. Protects your plant against high fuel prices or shortages. Impartial Iron Fireman survey will help you determine which fuels are best fitted for your operation.

IRON FIREMAN

THE IRON FIREMAN

AUTOMATIC FIRING EQUIPMENT FOR { OIL GAS COAL

For troublesome connections . . .

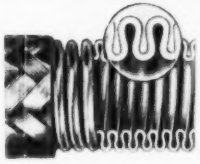


CMH

FLEXIBLE METAL HOSE offers the economical, dependable solution

Scores of troublesome connection problems where there is movement between parts, misalignment, vibration or expansion and contraction are effectively solved with CMH Flexible Metal Hose. Manufactured in a variety of types and a variety of metals, CMH Flexible Metal Hose is available for pressures from vacuum to 12,000 psi (burst) and for temperatures from sub zero to 1600° F.

If you do not already have literature describing the CMH line of flexible metal hose products, write for it, today, mentioning the types of connection problems you have.



CMH corrugated metal hose is manufactured in steel, bronze, stainless steel and other alloys and is available with or without metal braid covering. Convoluted hose, conduits, expansion joints, bellows and specialty items are also included in the CMH line.

Flexon identifies CMH products that have served industry for over 48 years.

CHICAGO METAL HOSE Corporation

1301 S. Third Avenue • Maywood, Illinois • Plants at Maywood, Elgin and Rock Falls, Ill.
In Canada: Canadian Metal Hose Co., Ltd., Brampton, Ont.

ONE DEPENDABLE SOURCE
for every flexible metal hose requirement

Convoluted and Corrugated Flexible Metal Hose in a Variety of Metals • Expansion Joints for Piping Systems
Stainless Steel and Brass Bellows • Flexible Metal Conduit and Armor • Assemblies of These Components

AMAZING "Ultrasonic" EYE
Sees Through Metal

at
Pittsburgh Piping
AND EQUIPMENT COMPANY

The illustration above shows P.P.&E. high pressure, high temperature piping being tested by means of a Reflectoscope which produces pulses of vibration waves of a frequency above hearing and transmits them at an angle into the metal through a searching unit which contains a sensitive quartz crystal.

The slightest discontinuity in the metal interrupts transmission of the waves, reflecting them back to the searching unit where the crystal converts mechanical vibrations into electrical energy. This voltage, amplified in the receiver, produces a visual indication of the defect on the screen of a cathode ray tube.

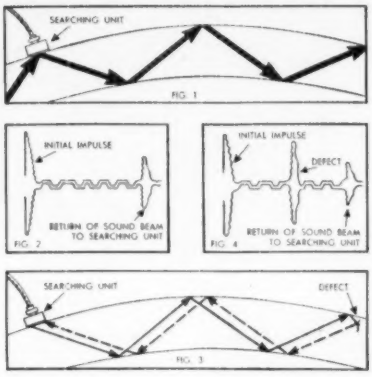
This unique testing method can detect flaws that can be found by no other non-destructive test. Its use assures quality control of materials and welding.

Look to Pittsburgh Piping and Equipment Company for leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

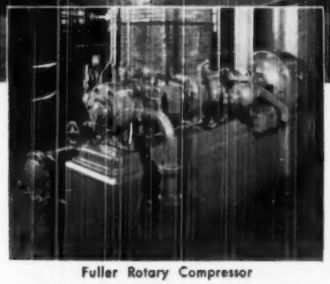
Pittsburgh Piping
AND EQUIPMENT COMPANY
10 Forty-Third Street—Pittsburgh, Penna.

Woolworth Building, New York
Whitehead Building, Atlanta
Book Tower, Detroit
525 Market Street, San Francisco
Peoples Gas Building, Chicago
Public Square Building, Cleveland
10 High Street, Boston
Heights State Bank Bldg., Houston

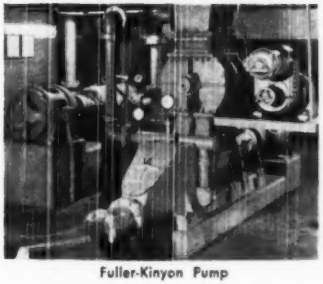
How the *"Ultrasonic"* Eye Works



Intermittent ultrasonic vibrations are transmitted angularly into the section under inspection, so that each sound beam is reflected away from its point of origin progressively from inner to outer pipe wall surface in a consistent pattern, as shown in Fig. 1, until it circles the pipe and returns to the searching unit. The uninterrupted flow and return of the beam is indicated on the oscilloscope screen as diagrammed in Fig. 2. Any discontinuity in the metal lying in the path of the sound beam will interrupt transmission as shown in Fig. 3, reflect the sound back to the searching unit, and provide a visual indication of its presence and location on the oscilloscope screen (see Fig. 4).



Fuller Rotary Compressor



Fuller-Kinyon Pump

FOR SOUND IDEAS ON CONVEYING DRY MATERIALS DON'T MISS *BOOTH 251* AT THE POWER SHOW

We'll be looking forward to seeing you—and to discussing with you the latest developments in the Fuller-Kinyon, Airveyor, and Airslide systems for handling fly ash as well as pulverized materials in process . . . also Fuller Rotary Compressors and Vacuum Pumps.

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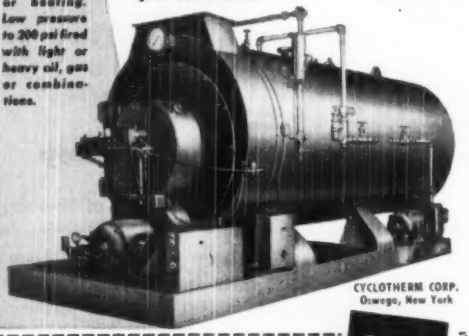

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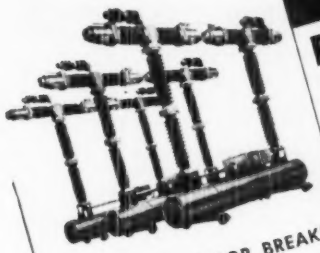

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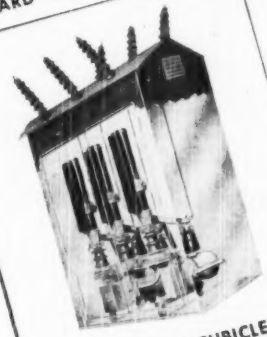

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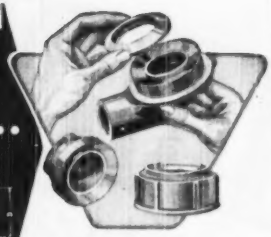

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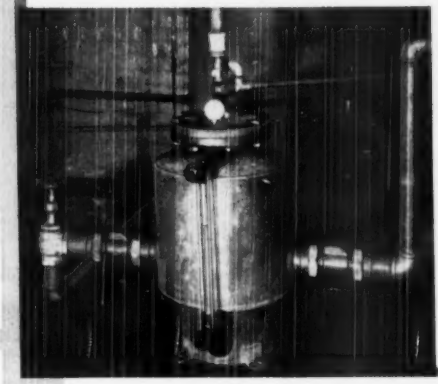

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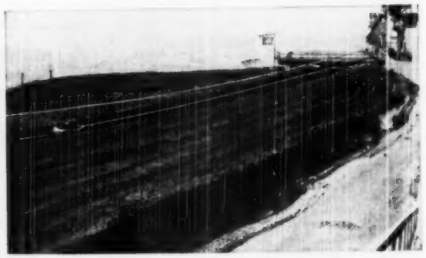

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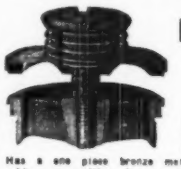

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By J. A. GERARDI, Vice Pres. & Treas.

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[SEAL] ELVA G. MASLIN
(My Commission expires March 30, 1952)

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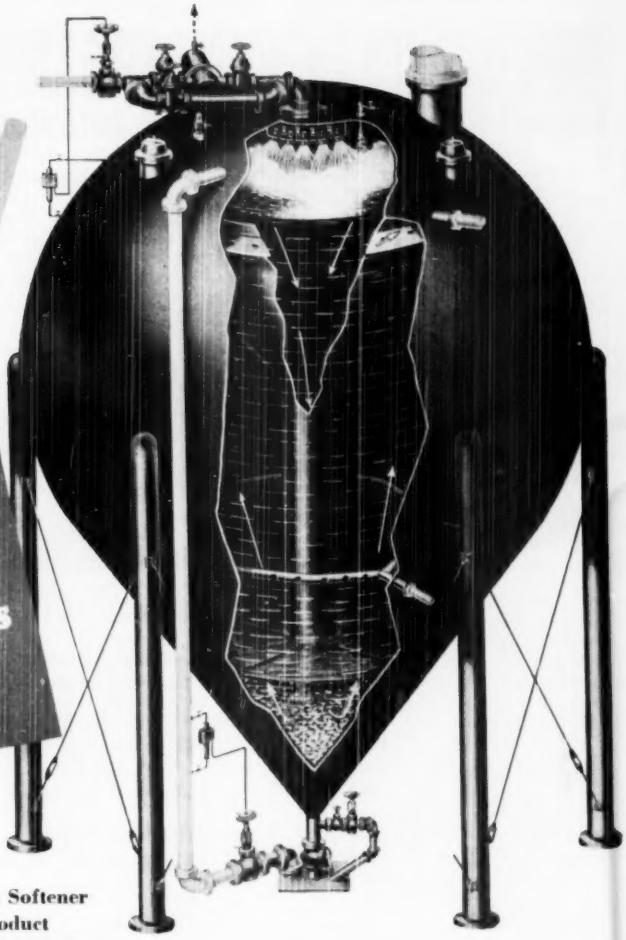
New!

GRAVER SPHERICONE for Hot Process Softening . . .



An improved design for Hot Process Softener Sedimentation Tanks . . . another product made possible by Graver's unique combination of chemical engineering skill and tank fabrication experience. • The new Graver Sphericone has many functional and structural advantages over other designs of hot process softener sedimentation tanks:

❶ *Clearest softened water* . . . because the expanding settling zone provides maximum settling area and lowest rising rates. This assures minimum load on filters . . . saves operator's time and filter media replacement.

❷ *Most efficient use of materials and space* . . . because of the exclusive Sphericone shape.

❸ *Uniform stress distribution* . . . because of the virtual elimination of knuckle radii.

GRAVER

The new Sphericone is made in Graver's own shops, together with all the other major component parts of the Graver Hot Process Softener. Write today for complete data.

GRAVER WATER CONDITIONING CO.

Division of Graver Tank & Mfg. Co., Inc.

GW 431

216 WEST 14th STREET, NEW YORK 11, N. Y.

THIS MAN WOULDN'T NEGLECT

A MACHINE IN HIS PLANT

...yet he hasn't had a Chest X-Ray!

He checks every piece of mechanical equipment he owns for wear, lubrication, efficiency.

Yet he fails to take the simple precaution of a Chest X-Ray to make sure he does not have tuberculosis. *Not because he's opposed to the X-Ray. Simply because he is not sufficiently informed—or just hasn't taken the time and trouble, or does not realize the seriousness of the problem.*

A Chest X-Ray is the first step toward detecting tuberculosis in its early stages. And in its early stages it can be cured with the least loss of time from work.

So, if you're the man above, that one simple reason should make you get your Chest X-Ray—*today*. But listen, see how serious this really is:

Between the ages of 15 and 34, tuberculosis leads all other diseases as a cause of death—although at no age are you safe from TB. Yet, if everyone does his part by getting a Chest X-Ray periodically, and the majority of cases thus discovered are followed up, we can eliminate TB entirely as a public health hazard!

Will you do your part today? Get a Chest X-Ray. It may mean your life!

Published in the public interest by:

McGRAW-HILL PUBLICATIONS

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NEW ADVERTISEMENTS received by Nov. 6 at the New York Office, 330 W. 42 St., N.Y. 18, will appear in the Dec. issue, subject to limitation of space available.

REPLIES (Box No.):
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NEW YORK: 330 W. 42 St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

OPERATING ENGINEER, for generating station. Must have second class license in Massachusetts. P. O. Box 507, Holyoke, Massachusetts.

WANTED CONTROL VALVE Designer—preferably young graduate engineer with some related experience. Exceptional opportunity to grow with progressive, nationally known company. P-7940, Power.

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (40 years recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N.Y.

SALARIED PERSONNEL $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

(Continued on page 288)

ELECTRICAL DRAFTSMAN
Four machine Wisconsin paper mill has opening for ambitious young Electrical Engineer. Should have paper mill or similar background and knowledge of N.E.C. and be familiar with plant electrical requirements, power and control equipment and wiring, both A.C. and D.C. Industrial electronic experience helpful. Salary based on individual ability with excellent opportunity for advancement. Replies confidential.
P-7916, POWER
520 No. Michigan Ave., Chicago 11, Ill.

STEAM ENGINEERS with electrical experience to train as Inspectors of Boilers and machinery for large Insurance Company. Minimum Requirements: Age 30 years; Education, High School; Experience, 5 years operation and maintenance. Normal starting salary with security, employee benefits, and promotion on merit. Reply stating age, experience, education.
P-7813, Power, 330 W. 42 St., N. Y. 18

Engineers — Executives — Technical Men
Salaried Positions, $4,000 to $30,000
This Confidential service for men who desire a new connection, will develop and conduct preliminary negotiations without risk to present position. Send name and address for details.
TOMSETT ASSOCIATES
1205-2 Berger Bldg., Pittsburgh 19, Pa.

ADDITIONAL EMPLOYMENT ADVERTISING on page 288

POWER PLANT PERSONNEL

An east coast utility now constructing a new high-pressure pulverized fuel generating station will accept applications for employment from qualified persons for the following positions.

CHEMIST

To assume full charge of laboratory. Must be experienced and thoroughly conversant with the analysis of water, fuel and lubricating oils. Must know water softening and conditioning and be able to interpret test results into instructions to operators for correction of unusual conditions.

CONTROL ROOM OPERATORS

Will be required to assist the Chief Operator in directing the operation of, and operating from the centralized control room all equipment such as pulverized fuel boilers, hydrogen-cooled turbine generators, switchboards, condensers, boiler feed pumps and all related auxiliaries.

INSTRUMENT MECHANIC

Previous experience on power plant instrument work essential. Must have a good working knowledge of and be able to service and repair such equipment as automatic combustion controls, flow meters, temperature recorders, gages, pH controllers and boiler meters. Must have a good understanding of electrical circuits as well as mechanical devices.

Job is centrally located near excellent residential community, good working conditions, forty-hour week (paid vacations, insurance, sick pay and retirement plan). All personnel selected for employment will be given complete job training at full pay to familiarize them with this particular installation before assuming their regular duties.

Include complete resume of experience and qualifications in first letter, together with recent photograph. Applications treated confidentially when desired.

P-6897, POWER
330 W. 42nd St., New York 18, N. Y.

Graduate
ENGINEERS

Good Opportunities for

POWER ENGINEERS—must have 8 to 12 years experience in operating, testing and maintaining power plant equipment, supervising power plant operations, making cost and evaluation studies, heat balance work, power cost accounting and the selection and installation of power equipment. Must be graduate.

ELECTRICAL ENGINEERS—must have 8 to 12 years broad experience in electrical design and operating problems of industrial plants with thorough knowledge of selection, installation, economical operation and maintenance of electrical equipment. Must be graduate.

HEATING & VENTILATING DESIGNERS—must be graduate with at least 5 years industrial heating and ventilating design experience or at least 12 years practical industrial design experience in this field.

HEATING & VENTILATING ENGINEERS—must be experienced graduate engineers capable of handling field and office problems in heating, ventilating and air conditioning design including economical evaluation of methods.

Give experience, education, age, references, personal history, salary received and salary expected. Please be complete and specific.

ALL INQUIRIES WILL BE CONSIDERED PROMPTLY AND KEPT CONFIDENTIAL.

E. I. du Pont de Nemours & Co. (Inc.)
Engineering Department Personnel
WILMINGTON 98, DELAWARE

New and Used Equipment Available for
POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION
Send for new list to
EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE — Two Rector St., New York 6, N. Y.

WAGNER

CERTIFIED REBUILT

ELECTRIC MOTORS & GENERATORS

Backed by 44 Years — *of Quality & Service*

M-G SETS

KW	Mfr	Input V	Output V
500	Whse.*	2300 AC	250 DC
300	G.E.*	2200/440 AC	275 DC
300	Whse.*	2300/4000 AC	600 DC
200	Ridgeway*	2300 AC	275 DC
200	Ridgeway*	2300/4000 AC	550 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Reliance*	220/440 AC	250 DC
150	Burke*	220/440 AC	250 AC
105	Century b.b	220/440 AC	70 DC
100	Allis Ch.* (2)	2200/440 AC	60 DC
100	Allis Ch.*	220/440 AC	250 DC
75	Gen. Elec. (3)	220/440 AC	125 DC
75	Cr. Wh. b.b. (2)	220/440 AC	250 DC
75	Star* b.b. NEW	220/440 AC	250 DC
65	Whse.	220/440 AC	250 DC
60	Gen. Elec.	220/440 AC	30 DC
50	Gen. Elec.	220/440 AC	250 DC
50	Gen. Elec. (2)	220/440 AC	125 DC
40	N.W. conv.	220 AC	250 DC
40	G.E.	220/440 AC	250 DC
35	G.E.	220/440 AC	48 DC
25	Burke	220/440 AC	125 DC

*Hyn. motor drive.

D. C. MOTORS

HP	Mfr	Type	Volts	Speed
200	Reliance	1970T	230	575/750
130	Cr. Wheeler b.b.	THFC	230	800
125	Gen. Elec.	RC 37	230	950
100	Whse.	SK181	230	450/900
100	Gen. Elec.	C	230	575/1000
100	Gen. Elec.	BC36	115	1150
75	Allis Ch.	E-140	230	500
75	Northw'n	K36	230	1750
75	Cr. Wh. NEW b.b.	CMC-HH	230	1150
75	Century NEW	DN	230	850
75	Whse.	SK160	230	850
60	Gen. Elec.	RC 38	230	425/850
60	Cr. Wh.	50H	230	700
60	Century NEW	DN	230	1150
60	Century NEW	DN	230	1750
50	Cr. Wheeler	FH	230	1750
50	Gen. Elec.	R.C. 14	230	1050
40/50	Whse.	SK160	230	500/1000
40	Cr. Wheeler	EH	230	1750
40	Whse.	SK 110L	230	1750
40	Whse. (2)	SK130	230	950
25/50	Gen. Elec.	CD123	230	575/1150
30	Whse.	SK81	230	1750
25	Whse.	SK150	230	300/1200

- EXPLOSION PROOF MOTORS—
- GEARHEAD MOTORS, AC & DC.
- FREQUENCY CHANGERS.
- CIRCUIT BREAKERS, AC & DC.
- SPEED REDUCERS

D. C. GENERATORS

HP	Mfr	Type	Volts	Speed
300	Gen. Elec. 1 brg.	DMC	275	720
200	Reliance	1970T	250	720
130	Cr. Wheeler b.b	THFC	250	1200
105	Century b.b.	1500 amp.	70	1200
100	Gen. Elec.	C	250	750
100	Gen. Elec.	DLC 125/250		675
75	Cr. Wh. NEW b.b.	HH	250	1450
75	Allis Ch.	H	250	750
75	Gen. Elec.	RC38	125	1200
65	Whse.	SK160	250	1100
50	Gen. Elec.	R.C. 14	250	1200
50	Cr. Wheeler	50H	250	900
40	Whse.	SK	250	1200
25	G.E. b.b.	CDM	25	1200

A. C. MOTORS—25 CYCLE

HP	Mfr	Type	Volts	Speed
150	Whse.	HF	440	500
150	Gen. Elec.	IK-16	440	750
100	Gen. Elec.	I-K	440	500
80	Gen. Elec. Int.	MTC5337	440	750
80	Gen. Elec.	I-K	440	750
80	Gen. Elec.	KT330	440	1500
40	Gen. Elec.	KT343	440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr	Type	Volts	Speed
625	Gen. Elec.	ATB	2300	450
625	G.E. 25 cycle	ATB	2300	750
500	Allis Ch.	3 brg.	240/480	360
300	Gen. Elec	ATB	600	720
275	G.E. 25 cycle	ATI	480	750
250	Whse.	G	2400/480	600
235	Gen. Elec.	ATB	240/480	600
187	Gen. Elec. (2)	ATB	240/480	900
150	Elec. Machy.	3 brg.	240/480	514
125	Gen. Elec.	ATB	240/480	720
125	Gen. Elec.	ATB	240/480	300
100	El. Machy.	R.B.	2400	900
75	G.E. b.b.	ATI	240/480	1200

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
1—	600	Gen. Elec.	I-M	360
1—	500	G.E. 3 brg.	I-M	450
1—	400	Gen. Elec.	I-M	514
1—	400	Gen. Elec. 2300V.	IM-EB	1800
1—	300	Whse. 2200V.	CW	600
2—	300	Allis Ch. 2300V.	ANT	720
1—	300	Gen. Elec. 2300V.	I-M	1800
1—	300	G.E. b.b. New	M566	900
1—	250	Allis Ch. 2300V.	ANT	514
1—	200	GE. 2200V.	I-M 17A	450
2—	200	Gen. Elec. 2200V.	I-M-18	900
1—	200	Gen. Elec.	I-M	360
2—	150	Gen. Elec. 2200V.	I-M-18	680
1—	150	G.E. 2200/4000V.	I-M	1200
1—	150	Allis Ch.	ANT	600
1—	150	Gen Elec.	I-M-17	450
1—	125	Gen. Elec.	IM-15	720
2—	100	Gen. Elec.	I-M	1800
1—	100	G.E. Vertical	MT553	1200
2—	100	Gen. Elec.	IM-15A	514
1—	100	Northwestern	HW75A	900
1—	100	Gen. Elec.	I-M	720
1—	75	Howell	SR443	1800
1—	75	Gen. Elec.	I-M-E13	1200
2—	75	Gen. Elec.	I-M-14	720
1—	75	Gen. Elec. 1st. duty	MTC5343	900
1—	75	Gen. Elec.	MT558	600
1—	75	G.E. 2300V.	MT556	720
1—	50	Allis Ch.	ANT	900
1—	50	Howell	SR437	1200
1—	50	Gen. Elec. Int.	ITC5013	600
1—	50	Gen. Elec.	I-M	720
1—	50	Gen. Elec.	MT536	1200
2—	40	Whse.	CW636A	1200
1—	40	Gen. Elec.	MT536	900
1—	40	Gen. Elec.	MT346	600

A. C. MOTORS—SYNCHRONOUS

HP	Mfr	Type	Volts	Speed
600	Gen. Elec. (2)	TS	2300	514
300	Whse.	G	2300/440	600
300	Gen. Elec.	ATI	440	720
230	G.E. 3 brg. .8PF	ATI	220/440	600
200	G.E.	TS	220/440	150
200	GE. 8PF	ATI	220/440	900
190	El. Machy.	3 brg	220/440	514
150	Gen. Elec.	ATI	220/440	300
100	American b.b.	YGH	220/440	900
125	El. Machy. (2)	B.B.	2400/4800	900
125	Whse. (2)	late	2200	1800
75	Whse.	8PF late	220/440	1200

A. C. MOTORS—SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu	HP	Mfr	Type	Speed
1—	500	Gen. Elec.	FT559	2000
1—	325	Gen Elec.	KT439	400
1—	300	Allis Ch.	AN	720
1—	250	Gen. Elec.	FT549AE	3600
1—	250	Gen. Elec.	FT549	3600
1—	250	Whse.	C5954A	720
1—	200	Allis Ch.	AN	1200
1—	200	Whse. b.b. NEW	C5875	1800
1—	150	Allis Ch. 2200V.	AR	900
1—	150	Gen. Elec. TEFC b.b.	K43338	1200
1—	150	Gen. Elec.	I-K-16	600
1—	150	Reliance b.b. NEW	B6015	1200
2—	150	Gen. Elec.	KF507	1200
1—	150	Gen. Elec. 2200V.	IK-H13A	1800
1—	125	Reliance b.b. NEW	C5085	1200
1—	125	Gen. Elec.	I-K-16	450
1—	125	Cont. 2200V. b.b.	SC	1800
2—	125	Rel. TEFC NEW	B6085	1200
1—	125	F.M. 2200V. vertical	UH-16D	1200
2—	100	Allis Ch. 2200V	AR216	1200
1—	100	Rel. TEFC NEW	C5063	1200
1—	100	Gen. Elec. b.b. NEW	K5048	1800
1—	100	Allis Ch.	AR	900
2—	100	Reliance TEFC	C6085	900
1—	75	Fair. Morse b.b.	HJQ	600
1—	75	Lima b.b.	R8505	1200
1—	75	Reliance b.b. NEW	C5084	900
1—	75	Reliance TEFC NEW	C5084	1200
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen. Elec.	KT339T	3600
2—	75	Reliance b.b. NEW	C504	1200
1—	60	G. E. hitorq	KG504	1200
1—	60	Howell b.b.	M584	720
2—	60	Reliance b.b. NEW	B504	1800
2—	60	Reliance TEFC NEW	C504	1200
2—	60	Reliance b.b. NEW	C504	1200
2—	60	Whse. H.T.	C8504	1800
1—	60	Wagner b.b.	RP444	3600
2—	50	Whse.	CS	1200
1—	50	Allis Ch. b.b.	ARX445	1800
1—	50	G.E. NEW b.b. HT	KG486	1800
2—	50	Reliance b.b. NEW	C445	1200
1—	50	Whse. bldlp	WL407	900
1—	50	Allis Ch. 2200V.	AR445	1800
1—	50	Gen. Elec.	KT546	720
1—	40	Gen. Elec.	KT542	720

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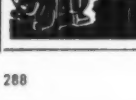

Arthur Wagner Co.

1435 W. RANDOLPH ST. MO nroe 6-1409 CHICAGO 7, ILLINOIS

SALES ENGINEER

Now it is possible to PREVENT formations and accumulations of Slag and Fireside deposits on boilers and furnaces. Our new System causes the complete combustion of the Combustibles in the furnace area. The Ash is deposited in the Ash Zone instead of entering the tube bank or building up, on the walls. Smoke Control is an accomplished fact. This System was developed through long research by a Nationally known, well established Manufacturer.

The importance of this new development to Industry offers an exceptional opportunity for large repeat business to Sales Engineers who have Combustion experience in the Industrial and Utility Power Plant fields.

Salary, Expenses and Commissions. Agents also considered.

State experience and qualifications in reply.

SW-6533, POWER

520 N. Michigan Ave., Chicago 11, Ill.

(Continued from page 287)

POSITIONS WANTED

MECHANICAL ENGINEER—Twenty-five years' experience, plant maintenance, operation modern power plants, refrigeration, air conditioning and water filtration plants. Fifteen years high pressure plants, some design and construction experience. Desire supervisory-engineer position with a utility, industrial plant or municipality. Registered engineer. Will relocate or travel. Available at once. PW-7948, Power.

POWER PLANT Engineer 39, B.S. deg. M.E. Mem. A.S.M.E. experience: 10 yr. operation, maintenance, betterment, steam and diesel plants, 3 yrd. electric welder. PW-7903, Power.

SELLING OPPORTUNITY WANTED

A WELL established incorporated company desires to represent a manufacturer of high grade power plant equipment in Northern Ohio territory. Address RA-7366, Power.

U.S. GOVERNMENT

THE TENNESSEE VALLEY AUTHORITY has opening in Knoxville, Tennessee, for Civil, Structural, Mechanical and Electrical Design Engineers, and for Architectural Draftsmen. Work is in connection with construction of large steam-electric and hydro-electric projects. Entrance salaries based on a 40-hour work week are $3900 and $4650 per annum, depending on training and experience, with provisions for automatic within-grade increases. Retirement, annual and sick leave benefits. Interested candidates should write to Tennessee Valley Authority, Division of Personnel, Knoxville, Tennessee.

IF THERE IS

Anything you want

that other readers of this paper can supply

OR—

Something you don't want

that other readers can use, advertise it in the

SEARCHLIGHT SECTION

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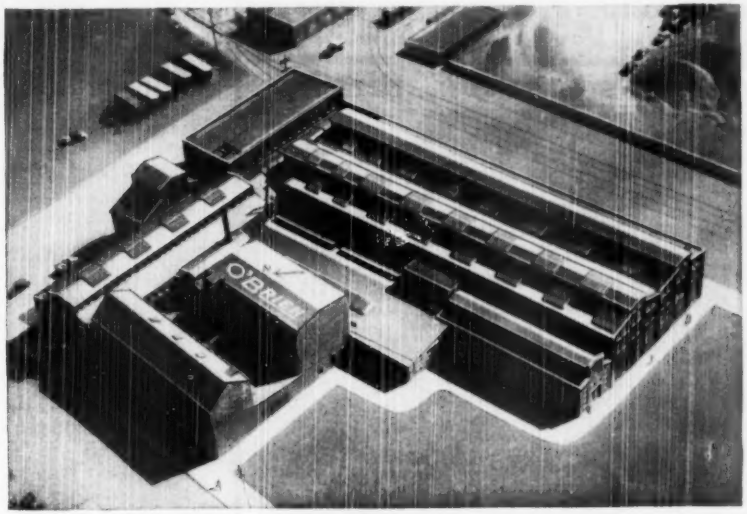

I N T E G R I T Y

NEW OFFICE, SHOWROOM, SHOPS AND WAREHOUSE
1545 N. DELAWARE AVE., PHILADELPHIA, PA.

ELECTRIC MOTORS

3 PHASE — 60 CYCLE

Q.	HP	Make	Type	Volts	Speed
1	1200	Cr. Wh.	Sl. Rg.	2300	257
1	1000	West.	CW	2300	450
1	650	G.E.	TS(Syn)	440	360
2	600	West.	Syn.	440	257
1	600	G.E.	IM	440/2300	600
1	350	West.	CW	440	600
1	350	G.E.	Syn.	440	900
1	315	G.E.	Syn.	2200	720
1	250	West.	CS	2200 (25 cyc)	375
1	250	West.	CS	2300	1200
1	200	West.	MW	440	600
2	180	G.E.	Syn.	4000	257
1	150	Al. Ch.	SC	220	1800
1	150	Ideal	Syn.	220	1200
1	150	El. Mch.	Syn.	220	900
1	150	G.E.	KT-558	440	900
1	125	Cent.	SC	440	1800
2	100	West.	CS	220	1800
1	100	Cent.	SC	220	1200
1	100	G.E.	IM	440	600
2	75	Cent.	SC	440	1200
1	75	West.	CW	440	1200
1	60	Ideal	SC	220	1200
1	60	West.	CW	440	600
2	50	Cent.	SC	220	1200
1	100	West.	SK183	230V. D.C.	400/1200
1	50	Cr. Wh.	CMC	230V. D.C.	300/1200

MOTOR GENERATOR SETS

1—1000KW GE MPC ATI 550v. 3/60/2300
1— 500KW GE MPC ATI 250v. 3/60/2300/720 rpm
2—400KW ELLIOTT COMPANY, 250 volt, 1200 rpm, 2300 volt, 60 cycle A.C. and D.C. Controls—New 1939
1—200KW G.E. 250 volt, 3/60/2300, 1200 rpm Synchronous
1—100KW G.E. 125 volt, 3/60/220/1200 rpm Synchronous
1— 50KW G.E. 250 volt, 3/60/240/1200 rpm
1— 50KW G.E. 125 volt, 3/60/220/1200 rpm
1— 40KW Ideal, 125 volt, 3/60/220/1200 rpm
1— 25KW Westinghouse SK, 250V. 1200 rpm, 3/60/440 synchronous

AIR COMPRESSORS

3—12,000 CFM Ingersoll Rand Turbo Compressors 3.25# pressure, 250 HP 3/60/440/3600 rpm motor drive.
1—3000CFM Sullivan Angle Compound 100 psi, 500 HP Syn. M.D. 3/60/2300
1—1050CFM Worthington, 18x11x14 100 psi, 257 RPM, Belted
1—1050CFM Ingersoll-Rand ES-1, 17¾x18, 50 psi, 275 RPM, V-belt
1—884CFM Chicago Type YCM, 125 Lb., 125 HP Syn. M.D. 3/60/440 Automatic Control
1—734CFM Sullivan Angle Class W13, Single Stage 18x13x8, 60 Lb., 300 RPM, v-belt, 100 HP
2—528 CFM Chicago NSB, 100 Lb., 285 RPM, V-belt, 14x12
2—368CFM Ingersoll ER-1, 285 RPM, 100 psi., 50 HP direct gear, M.D., 3/60/220
1—294 CFM Ingersoll ES-1, 10x11 Direct Syn., M.D., 3/60/440, 100 psi., automatic control
1—229CFM NEW Chicago PB 4 Air Cooled, 870 RPM, 125 Lb., V-belted, 50 HP, M.D.
1—245CFM IR-10x10 ER-1, 125 Lb.
1—215CFM Penna. 3A—10x8, 50 Lb.
1—211CFM NEW Chicago 9x9 T-B Horizontal 100 psi, V-belt
2—173CFM Ingersoll ER-1, 9x8, 300 RPM, 100 Lb., V-belt
3—120 CFM I-R—8x6 ER-1, 55 Lb.
1—92CFM I-R—7x6, ER-1, 100 Lb.
1—67CFM Chicago NSB—6x6—150 Lb.

DIESEL GENERATORS

1—1000KVA Hamilton Model 99DA, 3/60/2300/600 rpm complete portable or stationary—never used.
200KW Fairbanks Morse, 250 v., D.C. 720 rpm 8 cylinder, 4 cycle. Complete—1940
200KW G.E.-Fairbanks Morse, 720 rpm, 3/60/220/440—8 cyl., 4 cycle—1940
156KVA Cummins LI 400 3/60/440/900 rpm—Radiator—Sw. Bd.
113KVA Waukesha Portable, 3/60/440, 1200 rpm 1944
100KVA Cooper Bessemer 8 cylinder, 900 rpm, 3/60/220
56KVA G.E.-Climax Gasoline Portable, 3/60/220/1200 rpm
40KVA NEW Chrysler 3/60/220—2 units
30KW Buda, 3/60/220/1200 rpm
20KW Le Roi Gasoline—1/60/110-220 volt

TURBO-GENERATORS

Non-Condensing

1—625KW West. 3/60/2300/3600 RPM, 125 Lb. psi, 6 Lb. B.P.
1—400KW West. 3/60/480, 150 psi., 10 Lb. B.P.
1—300KW Elliott (New 1941) 250 Volt D.C., 150 Lb. I.S.P., 20 Lb. B.P.
1—300KW G.E. 3/60/2300/100 p.s.i. 0-15 Lb. B.P.
1—300KW G.E. 3/60/2300/3600 RPM, 175 psi, 5 Lb. B.P.
1—160KW West. 3/60/220/3600 RPM, 125 Lb. psi., 10 Lb. B.P.
1—160KW Ridgeway 4 Valve Steam Engine Generator, 3/60/220
1—150KW NEW West. 250 Volt D.C. 225 Psi., 25 B.P.
1—100KW NEW 3/60/220 150/200 psi. 0/30 Lb. B.P.
1—50KW West. 3/60/220/1800 RPM, 150 psi. 10 Lb. B.P.
1—35KW G.E. 125 volt D.C., 3600 RPM

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MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

WRITE FOR STOCK LIST No. 1622

VARIABLE VOLTAGE DRIVES

40 HP Reliance Variable Voltage Drives, each Consisting of:
1—40 KW 250 Volt Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing leg forward, leg reverse, run, fast, slow, and stop, and motor operated field rheostat.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	HP	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTC-5201
2	10	1140	440	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11‡	820	550	G.E.	ITC-5008
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	18	680	440	West.	MW-316
1	20	860	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	350	220	Warner	BR
2	25	720	440	Wagner	22VBR
1	30	865	440	West.	CW-646
1	30	350	440	G.E.	MT-332
1	30	675	440	G.E.	MT-336
2	35	600	440	F-M	HV-H16A
2	40	865	2200	Al.Ch.	ARY-223C
1	40	560	440	G.E.	MT-346
2	50	1150	440	G.E.	M-536
1	50	860	440	West.	HF-12A
2	50	570	440	G.E.	MT-552
5	54‡	550	220	G.E.	IQC-5013***
21	60	685	440	West.	CW-758
1	60	570	550	G.E.	MTC-5546
1	60	345	550	West.	CW-938
1	80‡	575	440	G.E.	MTC-5352
2	125	430	440	G.E.	IL-16
2	150	1750	440	G.E.	MTP-549
1	175	865	550	West.	CW-1002
2	200	600	550*	G.E.	IM-17
1	200	495	2200	G.E.	IM-17A
2	250	600	2300†	G.E.	IM-17
3	300	900	140	G.E.	IM-17
2	300	880	2200	G.E.	IM-17A
4	350	1775	2300	G.E.	IM-E15A
2	350	880	2200	G.E.	IM-17A
1	400	505	550	West.	CW
1	600	1770	440	G.E.	IM-E15C
1	650**	360	440	G.E.	MT-442Y
1	700	735	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts.
‡Intermittent rating. *** 2 phase.
** New. ‡‡ 25 cycle.
†Also 440 or 550 volts. *Also 440 or 2300 volts

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding & Direct Connected Exciter.

Qn.	KVA	RPM	Make	Volts
4	18.7	1800	Columbia	240/120
3	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D. C. MOTORS

Qn.	HP	Speed	Make	Type
10	3	850	Reliance	Y-23T
25	2½	850	West.	SK-30
1	7½	1150	G.E.	CDM-65
3	7½	850	G.E.	CD-75
10	10**	1750	Kimble	BA-324
5	10**	1150	Al.Ch.	EB-80
2	10	850	West.	SK-83
10	13½**	660	West.	SK-93
3	15	1750	G.E.	CD-78
1	15	825	West.	SK-96
1	20	1750	L.A.	ONA-L851
1	20	1750/1310	West.	SK-83
2	20	1150	G.E.	RC-30
1	20	750	West.	SK-110L
17	25	825	West	SK-120
1	30	1100	G.E.	RC-12
1	40	1700	West.	SK-103
1	40	750	G.E.	RC-34
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
1	60	1750/1310	West.	SK-142
1	150	700	Al.Ch.	
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	HP	Speed	Make	Type
6	5/7½	600/1800	G.E.	RA-3C
1	10	400/1600	Reliance	T-92T
2	10/15	600/2400	Reliance	T-92T
1	12½	230/240	West.	SK-130
10	12½**	600	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1600	G.E.	RF-11
1	20/25	100/1200	West.	SK-153
1	25	400/1600	G.E.	RF-13
1	25	500/1500	G.E.	RF-12
1	30/39	300/1200	G.E.	RF-13
1	30	400/1200	West	SK-163
1	30/40**	400/1600	G.E.	CD-1236
1	35	800/1800	West	SK-143
1	40/50	400/1400	Reliance	T-461
1	75	500/1500	Cr.Wh.	CCM
1	75	375/750	Cr.Wh.	CMC-125M
3	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	240/500	West.	SK-220
2	375	350/800	G.E.	MPC

**New.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment Is Located In Our Cleveland Warehouse. We Have Controls for Most Items Listed.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy. Totally Enclosed Fan Cooled, Ball Bearing

Qn.	HP	RPM	Volts	Make	Type
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
5	7.5	1740	440	G.E.	K-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-EXP
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1760	220	G.E.	K-365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	40	3565	440	G.E.	KF-4058

SPLASHPROOF, BALL BEARING

Qn.	HP	RPM	Volts	Make	Type
25	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-264
1	5	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-365
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
3	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	150	1775	440	L.A.	FX-1168
3	150	880	440	L.A.	FX-1368
1	150	700	440	G.E.	KF-6335
1	200	885	440	L.A.	FS-1378

OPEN TYPE MOTORS

Qn.	HP	Speed	Volts	Make	Type
1	15	3485	220	Reliance	AA-B3247
5	15**	1735	440	Century	SC326
1	15	1200	220	G.E.	KT-502
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RP1-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-522
1	25	1800	220	G.E.	KT-312
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-356***
2	25**	875	440	Master	PB-405
2	25	575	440	G.E.	KT-542
3	30	1550	550	G.E.	K-3648
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3545	220	G.E.	KF-4048
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP6-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-546
1	75	1160	440	West.	CS-962C
1	75	870	220	West.	CS-766A
2	75	865	2300	G.E.	KT-552
1	100	690	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	600	2200	West.	CS-930
1	100	495	2300	Al.Ch.	AN
2	125	435	440	Al.Ch.	AR
2	125	400	2300	G.E.	I-17-FR
1	200	580	550‡‡	G.E.	KT-5668
2	300	587	2200	West.	CS-39A
1	400	1165	2200	G.E.	IK-E15B
1	500	1200	440	G.E.	KTP-567
1	700	1800	2300	West.	CS-4-391D-12
			4000		

220 volt motors can be reconnected for 440 volts.
**New. ***2 Phase. ‡‡Reconnectable for 440 volts.

G. E. DYNAMOMETERS

Cradle Type, with control and Dial Scale.
(Write for Complete Specifications.)

Qn.	HP	DC Volts	RPM	Type
1	50/75	250	1650/4000	TLC-20
1	200	250	1200	C

MOTOR GENERATOR SETS

125 and 250 Volts D. C.
(Write for complete Specifications)

KW	Make	RPM	DC Volts	AC Volts
2	Cont.	1750	125	220/440
7.5**	West.	1455	125	380/220§
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
10	West.	1150	250	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440§
16	West.	1750	125	220/440
20	West.	1750	250	220/440
25	G.E.	1200	125	220/440
30	G.E.	1800	250	220/440
30	Al.Ch.	1750	125	220/440
50	West.	1760	250	220/440
50	G.E.	1720	125	220/240†
75	G.E.*	1200	125	220/240

Note: 3KW, 5KW & 7.5KW, 250V Sets Available
**New. *Synch. Motor Driven. §50 Cy. †25 Cy.

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVE. CLEVELAND 14, OHIO

MOTOR GENERATOR SETS

1—500 KW G.E. Syn. 250 V. 900 RPM
2—300 KW G.E. Syn. 250 V. 1200 RPM
1—300 KW G.E. Syn. 600 V. 1200 RPM
1—240 KW G.E. Syn. 250 V. 1200 RPM
1—200 KW G.E. Syn. 250 V. 1200 RPM
1—100 KW G.E. Ind. 250 V. 1200 RPM

ROTARY CONVERTER

1—150 KW G.E. Syn. 250 V. 1200 RPM HCC, 6 Ph., 60 Cy. Transformers

ARMATURES

1—500 KW G.E. 250 V. MPC Gen. 900 RPM
1—300 KW G.E. 600 V. HCC Conv. 1200 RPM

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502 Grant Bldg., Pittsburgh 19, Pa.

CENTRIFUGAL PUMPS

4—Allis Chalmers Electrifugal, Size 6"x5" SSL 20 H.P. 220 or 440 Volt 3/60—1800 RPM, Splash proof. Cap. 1000 GPM, 60' head.
2—Fairbanks Morse, Size 3"—5532 with 15 H.P., 220/440/3/60—1800 RPM, Splash proof motors. Cap. 300 GPM, 100' head.
2—Vacuum, Size 9 Nash Hytor, 50 CFM, 15" hg.
2—Beach-Russ, Size 5 Vacuum, 60 CFM, 26" hg.

HOISTS

1—P & H Size HR-2, 4000#, 32 ft./min., W.M.D. Trolley, 125 ft/min.
1—P & H Zip Lift, 2000#, 220/3/60—18' lift.

MOTORS

1—50 H.P. G.E. Slip ring 220/3/60—900 RPM with drum and grids.
700—¼ H.P. and ½ H.P. new capacitor motors, 110/220/3/60, 1800 RPM.

Large stock of pumps, motors and air compressors at all times. Let us have your inquiries.

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100 KW 200 KW

General Motors Diesel engines, 8 cyl., Model 8-268A, 6¼" bore x 7" stroke. Direct conn. to: 200 KW WESTINGHOUSE ALTERNATORS, 3 phase, 60 cy., 440 V., including switchboards.

ALSO—COMPLETELY REBUILT

3 cylinder General Motors Diesel Engine Sets Direct Conn. to: 100 KW CENTURY ALTERNATORS, 3 phase, 60 cy., 440 Volt, Inc. switchboards.
OTHER SIZES IN STOCK FROM 10 to 1000 KW. Ready for immediate shipment.

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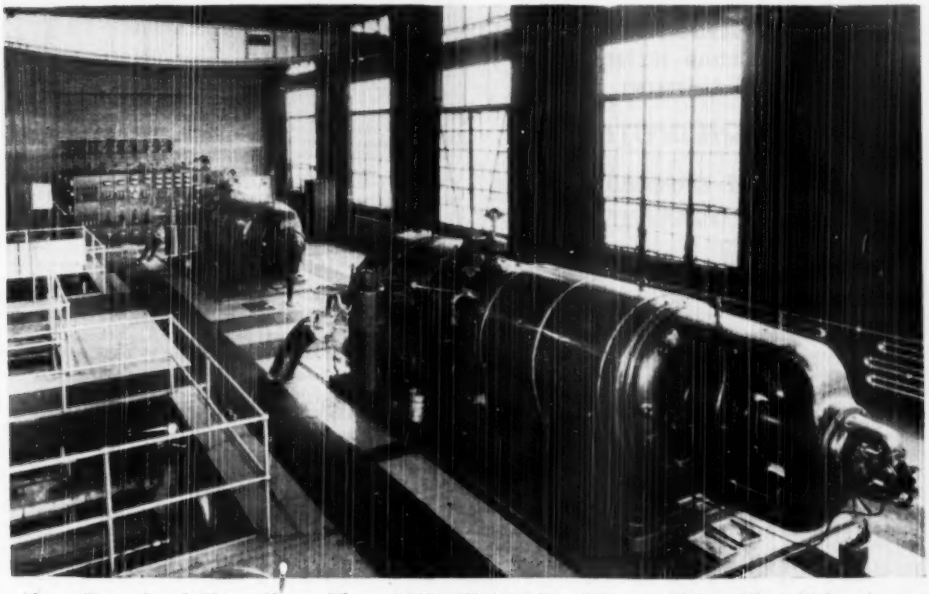
2500 KW. @ .80, 3125-KVA.

Two (2) GENERAL ELECTRIC TURBO-GENERATORS

VERY HIGH GRADE UNITS

GUARANTEED TO PASS MOST RIGID INSPECTION



Above Reproduced Photo Shows These 2-3125 KVA., G.E. as They are Today. Photo Taken August 26, 1950, Are Duplicates.

Also 1—20,000 KW., G.E. Condensing Turbo-Generator: Complete; Immediate Delivery.

GENERAL SPECIFICATIONS

Turbines

MFR.—General Electric Co.
Capacity—2500-KW.
Type—Curtis, 4-Stage, Condensing
Steam (Initial)—160/225#
Speed—3600-RPM.
Superheat—450-FTT
Serial Nos. 23297: 23299

Generators

MFR.—General Electric Co.
Capacity—2500 KW., 80%: 3125-KVA.
Speed—3600-RPM.
Frequency—3/60/2300/4160/6900
Type—ATB-2
Serial Nos. 2005968: 2005971

CONDENSERS: 2—6750-sq. ft., Surface Alberger, 2-Pass: With Auxiliaries
SWITCHBOARDS: 2—NBS., Complete with Instruments
EXCITERS: 2—Direct Connected, 25-KW., 125-v.

Also in Our Stock: 25 Complete Condensing Turbo-Generators, Any Capacity. From 12,500-KVA., to 300-KVA.

NON-CONDENSING UNITS: 2000-KW., to 500-KW., Any Capacity
SEND US YOUR SPECIFICATIONS

THESE TWO (2) TURBINE-GENERATORS HAVE BEEN EXCEPTIONALLY WELL MAINTAINED! are in Excellent Condition: Will pass Inspection.
Drawings, Photos, Complete Data Furnished on Request.
Many Other Sizes of Turbines in Our Stock: Send Us Your Specs. for Diesel Engines — Boilers

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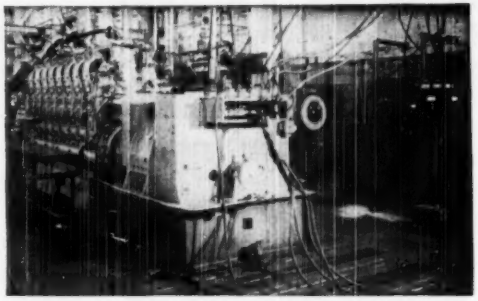
AT 40% TO 60% SAVINGS

EACH ENGINE "REMANUFACTURED"
AND "FULL-LOAD TESTED"
PRIOR TO SHIPMENT

INSPECTION INVITED

ALL EQUIPMENT OFFERED WITH ONE YEAR GUARANTEE



VIEW OF ENGINE TEST STAND FACILITIES AT OUR PLANT IN SAUSALITO (S.F.) CALIF. ALL ENGINE TESTING CONFORMS TO DIESEL MANUFACTURERS' STANDARD METHODS.

A PARTIAL LIST OF OUR INVENTORY

KVA	MAKE	MODEL	HP	RPM	KVA	MAKE	MODEL	HP	RPM
1875	Fairbanks Morse	33E16	2000	300	312.5	Clark	MD-4	375	327
1420	Fairbanks Morse	38D	1600	720	300	Fairbanks Morse	YVA	360	257
1250	General Motors	16-278A	1600	720	250	General Motors	8-268A	350	1200
1000	General Motors	12-278A	1200	720	237	Ingersoll-Rand	S	255	600
937.5	General Motors	12-567	1080	720	200	Buckeye	80	240	600
625	Alco	6-12½x13T	750	600	156	Buckeye	E	190	400
425	Baldwin	VO	510	450	125	General Motors	3-268A	150	1200
400	Buckeye	80	480	600	121	Fairbanks Morse	32E14	140	300
375	Enterprise	DSG-6	450	450	75	General Motors	6-71	90	1200
330	Superior	KNA	396	514	62.5	Int'l Harvester	UD-18	76	1200
312.5	General Motors	8-268A	450	1200	50	General Motors	4-71	60	1200

A. G. SCHOONMAKER COMPANY, INC.

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SHOPS AND WAREHOUSE: JERSEY CITY, N. J. AND SAUSALITO (S.F.) CALIFORNIA

NORTHERN METAL CO. — MACHINERY at REDUCED PRICES

DIESEL GENERATORS

100 K.W. Allis Chalmers. 1944. 3/60/120/450.
Exciter: 3 K.W. 120 V. D.C.
Diesel Engine: Lorimer. Model F5SS. 150 H.P. 7½"x9½".
5 cylinder, with electric starting motor.

MOTORS

Westinghouse. 1944. Synchronous—Induction.
60 Pole. 3300 S.H.P. 3 Phase. 82.5 Cycles. 2200 Volts.
165 R.P.M. Power Factor 100%.
Exciter: 125 Volts D.C. Load Factor 100%. 1944.

BOILERS

WATER TUBE. Babcock & Wilcox. 1945. 2 Drum. Bent Tube. Economisers. Internal Desuperheater. Superheaters. W.P. 400 P.S.I. Hydrostatic Press. 718 P.S.I. Heating Surfaces: 2441 sq. ft. Superheater 350 sq. ft. Economiser 1620 sq. ft. 3 Todd "Hex Press" Fuel Oil Burners. Diamond Soot Blowers. Auxiliaries available.

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TRANSFORMERS — FOR SALE

1 Phase 60 Cycle
Rebuilt and Guaranteed

3—1250 KVA—G.E. 13800 2400
3—1000 KVA—G.E. 13800 480
3—1250 KVA—G.E. 6900 480
3—1000 KVA—G.E. 4800 480
6— 500 KVA—West. 2400 240/480
9— 333 KVA—West. 6900 480
9— 333 KVA—West. 4800 480
9— 333 KVA—West. 2400 480
3— 200 KVA—G.E. 2400 480/240
3— 150 KVA—G.E. 2400 480/240
3— 100 KVA—G.E. 2400 480/240
3— 100 KVA — G.E. 6900/11950Y 460/230
3— 75 KVA—West. 4800/2400 460/230
3— 50 KVA—G.E. 4800/2400 460/230/115
3— 37½ KVA — G.E. 4800/2400 460/230/115

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LIQUIDATION SALE — Modern Equipment

DIESEL ENGINES

HP	MAKE	MODEL	RPM	CYCLE
1800	General Motors	16-258S	900	4
1600	General Motors	16-278A	720	2
1600	Fairbanks Morse	38D O/P	720	2
1600	Hamilton	RB99-D.A.	700	2
900	General Motors	12-567 ATL	750	2
900	General Motors	6051 (quads)	650	2
500	Superior	6-cyl.	514	4
215	Superior	VDM B	600	4

DIESEL GENERATOR SETS

DC	1200 KW	525V	750 RPM	General Motors	16-278A	
	650 KW	240V	750 RPM	General Motors	12-567	
	125 KW	120/240	600 RPM	Superior	VDMB	
	100 KW	120/240	1200 RPM	General Motors	3-268A	
	60 KW	120V	1200 RPM	Buda	909	
AC	200 KW	3/60/450	1200 RPM	General Motors	8-268A	rebuilt
	100 KW	3/60/450	1200 RPM	General Motors	3-268A	rebuilt

3—150 KW 3/60460 600 RPM Buckeye model 80 diesel
9—100 KW 3/60/460 600 RPM Worthington BB5 diesel
With Westinghouse generators, exciters, cooling systems, starting equipment, switchboard, silencers, etc. Units practically new.

TURBO-GENERATORS—D.C.

1—375 KW 180/240 V GE Shunt. 1200 non-cond.
5—300 KW 120 V Hendy Compd. 1200 cond.
1—300 KW 240 V GE Compd. 1200 cond.
12—150 KW 120 V Whse. Shunt. 1200 cond.
12— 60 KW 120 V Whse. Stab. Sh. 1800 cond.
1— 25 KW 125 V 3600

MOTORS—DC

1500 HP 525 V DC 600 RPM W'hse.
1362 HP 415 V DC 1200 RPM Elliott
667 HP 375 V DC 1300 RPM Elliott
444 HP 250 V DC 900 RPM Elliott
222 HP 230 V DC 3050 HP W'hse
50 HP 230 V DC 525/1800 W'hse.
15 HP 120 V DC 500 RPM Diehl

GENERATORS—DC

1200 KW 525 V 750 RPM All. Chalm.
1075 KW 375 V 750 RPM Elliott
700 KW 240 V 500/720 Elliott
375 KW 240 V 1200 W'hse.

AIR COMPRESSOR

2000 CFM at 90 psi, 3 stages, driven by 450 HP diesel mfr. Clark Bros.

NEW PUSHBUTTON STARTERS

2000—Line Starters, magnetic, for AC motors, rated 7½ HP at 440V, 5 HP at 230V, 3 HP at 110V, mfd. by Ward Leonard and Westinghouse.
80—Line Starters, 115V DC, 9.5 amps, G.E. (NEW).

HIGH PRESSURE AIR COMPRESSORS
CENTRIFUGES
EVAPORATORS
TRANSFORMERS
SOOT BLOWERS
WINCH TYPE MOTORS

MODERN TURBO GENERATORS AC

1—2000 KW 3 phase 60 cycle 3600 RPM 480/600/2400/4160V type ATB-2 Form HL driven by steam turbine, 410# steam pressure, exhaust 2½" Hg abs., 275 deg. F superheat. General Electric Company. (also 2900 at 1700 V)
2—250 KW G.E. type ATI 3/60/450 1200 RPM condensing.
2—200 KW Westinghse. 3/60/450 1200 RPM condensing (unused).
6—200 KW G.E. type ATB 3/60/450 1200 RPM cond. and non-cond.

GENERATORS—AC

3—2000 KW 3/60/480/600/2400/4160 3600 RPM type ATB-2 Form HL. Mfd. by G.E.

MOTORS—AC

4—6000 HP at 93-1/3 cycle 400 RPM or 3800 HP at 60 cycle 257 RPM—G.E.

ICE PLANTS (New)

2—22 ton capacity, Freon 12, mfd. by Frick.

BOILERS

10—Cleaver-Brooks, 2000# steam pr. hr 35# press.
2—Cyclotherm 3000 pounds steam per hour, 125# press.
1—Express Boilers, modified D type, Foster Wheeler 30,000# steam/hr., 435#.
2—Type "D", water tube, Foster Wheeler, 15000# steam/hr., 275# press.

STEAM TURBINES

All New

1—110 HP 250# steam, 10# each. 1200 RPM Sturtevant
10—56.5 HP, 300-475# steam, 10-15# each. 1225-1600 RPM, Sturtevant

CONDENSERS

(Most are new)

No.	Sq. Ft.	Make	Passes	Tubes	
2	8000	Ch. Wheeler	2	Brass	⅝"
4	3300	Str. Wells	2	Alu-Brass	¾"
4	1050	Conseco	2	Cu Ni	⅝"
30	400	All. Chalm.	2	Brass	⅝"
4	300	Wheeler	2	Cu Ni	⅝"
8	155	Conseco	2	Brass	¾"

AIR EJECTORS

1—Foster Wheeler for 3800 sq. ft. cond.
5—Westinghouse type C-42, for 9300 sq. ft. condenser.
2—Ingersoll Rand 275# press., for 8250 sq. ft. condenser.
2—C. H. Wheeler, type 4H240, for 8000 sq. ft. condenser.

HYDRAULIC PUMPS

Vertical quintuplex pumps, 450 GPM, 1750 psi, 128 RPM, mfr. Aldrich, with 700 HP 3/60/2300 motors.

AXIAL FLOW FANS

16,000 CFM 3" S.P. 3/60/440 Buffalo
12,000 CFM 3" S.P. 3/60/440 Clarage
35,000 CFM 1" S.P. 230V DC Wing

BLOWERS — AIR PUMP

8—Blowers, Roots Connersville, size 16x18, serial No. 14862, capacity 5000 CFM against 6 lb. sq. in. ga. pressure or 3450 CFM when creating 28" Hg vacuum, with 200 HP motors 3/60/2200. Also available: 1 R.C. Blower, size 20x23 with 350 HP motor.
1—Air Pump, Ingersoll Rand, type FB548, 5500 CFM, discharge press. 24.22 abs., intake press. 20.61 abs., with 125 HP motor 3/60/2300.
1—Air Pump, Ingersoll Rand, type FB548, 6690 CFM, discharge press. 20.86 abs., intake press. 17.10 abs., with 150 HP motor 3/60/2300.
1—Blower, Buffalo, size 60, type B, with 150 HP motor 3/60/2200.

WIRE ROPE SLINGS

Dia. from ⅜" to 2½"
Length from 10 ft. to 150 ft.

HOISTS

15—15,000# pull at 78 FPM, 3360# pull at 348 FPM and 2 auxiliary drums. Driven by Chrysler 20.35 H.P. gasoline engines. (NEW).

BOILER FEED PUMPS
FIRE, IRRIGATION AND GENERAL SERVICE PUMPS
HEAT TREATING FURNACES
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REDUCTION GEARS

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BREW-WOLTMAN OFFERS

TURBINE UNITS

1—5000 KVA West. Extr. Cond. 60 cy. 2300 V. 385-lb.
1—5000 KVA G.E. Non-C. 60 cy. 13200 V. 600-lb.
1—2500 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lb. 40-lb BP
1—2500 KVA G. E. Extr. Cond. 60 cy. 480 V. 185-200 lb. steel valve chest.
1—2500 KVA West. Non-C. 60 cy. 2300 V. 150-200 lb. 30-lb. BP
1—2500 KVA G. E. Cond. 60 cy. 2300 V. 150-lb.
2—2250 KVA G. E. Cond. 60 cy. 240-400 lb.
1—1875 KVA Moore Cond. 60 cy. 2300 V. 225-lb.
1—1563 KVA G. E. Extr. Cond. 60 cy. 480 V. 200-lb.
1—1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lb.
2—1250 KVA Elliott Cond. 60 cy. 480 V. 150-200 lb. 600" Surface Condenser
1—1250 KVA Moore Cond. 60 cy. 2300 V. 225-lb.
1— 625 KVA G.E. Cond. 60 cy. 240 V. 200-lb.
1— 625 KVA Moore Extr. Cond. 60 cy. 2300 V. 225-lb.
1— 25 KW Allis Non-C. DC 125 V. Exciter Dual drive turbine & motor.

DIESEL ENGINE UNITS

2—1400 HP Fair. Morse 2400 V. 60 cy.
3— 700 HP Gen. Motors 2300 V. 60 cy.
3— 650 HP Amer. Loco. 440 V. 60 cy.
1— 600 HP Fair. Morse 2400 V. 60 cy.

STEAM ENGINE UNITS

1—1125 KVA Hamilton Uniflow 2300 V.
1— 312 KVA Ames Uniflow 240 V.
1— 250 KVA Ames Vertical Uniflow 480 V.
1— 250 KVA Ames Uniflow 400 V.
2— 187 KVA Ames Vertical Uniflow 240/480 V.

ROTARIES — 60 CY.

QU.	KW	MFR.	VOLTS D.C.	VOLTS TRANSF.	RPM
1	3250	G.E.	225/285	13800	300
1	2000	A.C.	600	4150	514
2	1000	West.	600	4150	720
1	1000	G.E.	600	13200	900 Auto.
3	750	West.	600	11000	1200 Auto.
2	500	West.	250	13200	1200
2	150	West.	250	2200	1200

SPECIALS

3—700 HP General Motors Diesel 8 cyl. 4 cy. 360 RPM dir. con. to 485 KW .8 PF 3/60/2300 V. generators.
2—1250 KVA Elliott 3/60/480 V. 3600 RPM generators dir. con. to 150-200 lb. IP 600° TT turbines with dir. con. exciters, surface condensers and pumps.

MERCURY ARC RECTIFIERS

2—4500 KW Ignitron 650 V. DC 13800 Trans.
2—4500 KW Multi Anode 600 V. DC 13800 Trans.
2—3250 KW Ignitron 650 V. DC 13800 Trans.
1—1000 KW Ignitron 600 V. DC 13800 Trans.

MOTOR GENERATOR SETS — 60 CY.

QU.	KW	MFR.	VOLTS D.C.	VOLTS A.C.	RPM
1	1500	West.	250	4000	514
2	1500	G.E.	600	4150	600
1	1000	G.E.	600	13200	514
1	500	West.	125	2300	720
1	300	West.	250	440	1200
2	250	C.W.	125/250	208	1200
1	200	G.E.	250/275	2300	1200
1	75	Star	240	440	1200
1	75	West.	125	440	1200

SYNCHRONOUS CONDENSERS

QU.	KVA	MFR.	VOLTAGE	RPM
1	2500	G.E.	2400/4160	720
1	2000	West.	2300	720
2	1500	G.E.	2400/4160	900
1	1500	G.E.	4800	900
1	1000	West.	2300	900

SYNCHRONOUS MOTORS — 60 CY.

QU.	HP	MFR.	VOLTAGE	RPM
1	4350	Cr. Wh.	13800	514
1	800	Ideal	4160/2400	1200
1	600	G.E.	440	360
2	350	G.E.	2300	257
1	300	G.E.	2300	600
1	300	West.	2300	900

FREQUENCY CHANGERS

1—3125 KVA G.E. 25/60 cy. 300 RPM
1—3000 KVA G.E. 60/25 cy. 300 RPM
2—2500 KVA G.E. 25/62½ cy. 750 RPM
1—2450 KVA G.E. 62½/25 cy. 750 RPM
1—1250 KVA G.E. 25/60 cy. 300 RPM
1—1250 KVA West. 25/60 cy. 300 RPM
2—1000 KVA G.E. 25/60 cy. 300 RPM
1— 500 KVA Al. Ch. 25/60 cy. 300 RPM

TRANSFORMERS — 60 CY.

1— 7500 KVA G.E. 138000—41000, 3 ph.
3— 3333 KVA West. 132000—7620/13200 Y
1— 2000 KVA G.E. 69000—13800/23900, 3 ph.
1— 700 KVA Al. Ch. 66000—2400, 3 ph.
3— 1000 KVA West. 66000—7200
1— 2500 KVA G.E. 59/73 KV, 5 taps, 3 ph.
3— 100 KVA West. 44000—7200/12470 Y
3— 75 KVA G.E. 44000—2300/4600
3— 8333 KVA West. 43800—13900
4— 6667 KVA G.E. 38100/66000Y—12700/22000 Y/13200
1—18750 KVA A.B.B. 34840—11000, 3 ph.
2—15000 KVA Al. Ch. 33000—12500, 3 ph.
2— 7500 KVA Al. Ch. 33000—13800, 3 ph.
1— 1500 KVA G.E. 33000—2300/4600, 3 ph.
3— 667 KVA G.E. 33000—2300/4600
6— 75 KVA Mol. 33000/16500—2300/6900
6— 50 KVA G.E. 33000—2300
2— 4500 KVA G.E. 27000—2300, 3 ph.
1— 3750 KVA West. 26400/13200—2400
4— 450 KVA Al. Ch. 25410/44000—13280/23000
2— 1000 KVA G.E. 22000/11000—2300, 3 ph.
2— 7500 KVA West. 13800 Rectifier Type
1— 750 KVA West. 13200—440
3— 333 KVA G.E. 13200—2400/4160
3— 200 KVA G.E. 11500—220/110
1— 200 KVA Mol. 11000—2300
1— 167 KVA G.E. 7200/12400—240/480
1— 1500 KVA West. 4000—2300, 3 ph. Auto.
3— 250 KVA Al. Ch. 2300—460
6— 75 KVA G.E. 480—120/240

OIL CIRCUIT BREAKERS

1— 600 A. 73 KV G.E. FHKO-139 Outdoor
1—1200 A. 34.5 KV G.E. FKO-339-1000 Outdoor
4—2000 A. 15 KV G.E. FKO-339-1000 Outdoor
4— 600 A. 15 KV G.E. FHKO-138-BS Outdoor
3— 600 A. 15 KV West. B-28-B-500 Indoor

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STEAM — ELECTRIC — HYDRO — DIESEL

"Export Orders Carefully Executed"

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1—140,000# New Steam Generator 600#, also Super
2—90,000# Boilers, 625#, 825° F.tt., Economizer and Air-heater
2—70,000# 500 psi
2—60,000# B&W 450# superheat
2—30,000# B&W 450# superheat
1—1000 HP Erie City Boiler, 200#
3—600 HP Box Header Straight Tube 200#
6—600 HP B&W Stirling, Super 200#
4—750 sq. Straight tube Edgemoor's 160#
1—45,000# F-W 450# 3 drum, water walled & economizer—superheat
1—1000 HP B&W
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS

1—10,000 KW Turbo-Generator—Cond.
1— 7,500 KW Turbo-Generator—Cond. 600#
1— 7,500 KW Turbo-Generator, Cond.
1— 5,000 KW NEW 400# Cond. Unit complete
1— 5,000 KW Turbo-Generator—Cond.
2— 3,000 KW & 2—2500 KW Cond.
3— 2,000 KW same as above
2— 1,500 KW same as above } Also 400# & 600# turbos
2— 1,250 KW same as above
2— 1,000 KW same as above
1— 500 KW same—Also 750 KW & 300 KW Units
Non-Cond.—300—500—750—1000—1500—2000

Complete Steam Plants with 2—1250 KW; 2—2500 KW; 2—3000 KW & 7500 KW
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CHICAGO PNEUMATIC T-S
STRAIGHT LINE, TIMKEN BEARING

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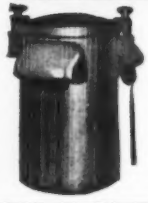

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One Year Guarantee.

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"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
SINCE 1912 — CINCINNATI 27, OHIO

asme — BOILERS — Nat'l B'd.

2—404 H.P. Springfield sectional header
5—300 H.P. Combustion Engineering Co.
1—250 H.P. Stirling, Class-H.
3—72" suspended H.R.T. single set

H. P. BREARLEY
34-23 91st STREET JACKSON HEIGHTS, N. Y.

POWER PLANT MACHINERY

STEAM TURBINE GENERATOR UNITS

3 Phase 60 Cycle

12,500 KVA General Electric condensing, 200# steam pressure, 500° FTT, 2400 volts, with surface condenser.

6,250 KVA Allis Chalmers condensing, 200# steam pressure, 500° FTT, 2400/4160 volts, with surface condenser.

5,000 KVA New General Electric non-condensing extraction, 600# steam pressure, 750° FTT, 125-150# extraction, 25-50# exhaust, 13,800 volts.

5,000 KVA Westinghouse condensing double extraction, 400# steam pressure, 600° FTT, 125# and 20# extraction, 480 volts, with surface condenser.

4,375 KVA General Electric condensing, 200# steam pressure, 500° FTT, 2300 volts, with surface condenser.

3,750 KVA Westinghouse condensing, 200# steam pressure, 500° FTT, 600 volts, with surface condenser.

3,125 KVA New General Electric condensing, 600# steam pressure, 750° FTT, 2400/4160 volts, with or without new surface condenser.

2,500 KVA New General Electric condensing, 400/600# steam pressure, 750° FTT, 100-150# extraction, 480/2400/4160 volts, with or without new surface condenser.

2,250 KVA New General Electric condensing, 400# steam pressure, 725° FTT, 2300 volts, with surface condenser.

1,875 KVA New General Electric non-condensing extraction, 400/600# steam pressure, 750° FTT, 100-150# extraction, 0-20# exhaust, 480/600/2300/4160 volts.

1,250 KVA Westinghouse condensing, 450# steam pressure, 750° FTT, 2400/4160 volts, with surface condenser.

1,250 KVA Westinghouse condensing extraction, 150-250# steam pressure, 600° FTT, 10# extraction, 480 volts, with surface condenser.

625 KVA Westinghouse non-condensing, 150-200# steam pressure, 600° FTT, 25# exhaust, 480 volts.

UNIFLOW ENGINE GENERATOR UNITS

3 Phase 60 Cycle

750 KVA Allis Chalmers-Ames vertical, 150# steam pressure, 5# exhaust, 2400/4160 volts.

625 KVA General Electric-Skinner horizontal, 150# steam pressure, 5# exhaust, 240 volts.

375 KVA General Electric-Skinner horizontal, 150# steam pressure, 5# exhaust, 240/480/2400/4160 volts.

312 KVA Crocker Wheeler-Skinner horizontal, 150# steam pressure, 5# exhaust, 480 volts.

250 KVA General Electric-Ames vertical, 150# steam pressure, 5# exhaust, 480 volts.

STEAM BOILERS

100,000 LBS. New Babcock & Wilcox boiler, 600# steam pressure, 850° FTT, oil fired.

60,000 LBS. Combustion Engineering boiler, 450# steam pressure, 600° FTT, with Coxe traveling grate stoker.

50,000 LBS. Springfield boiler, 250# steam pressure, 506° FTT, with Firite stoker.

30,000 LBS. New Babcock & Wilcox boiler, package type, 435# steam pressure, 750° FTT, oil or gas fired.

25,000 LBS. Babcock & Wilcox boiler, 250# steam pressure, with Iron Fireman stoker.

DIESEL ENGINE GENERATOR UNITS

3 Phase 60 Cycle

1,563 KVA Fairbanks-Morse, 2400 volts, 300 RPM.

1,225 KVA Fairbanks-Morse, 2400 volts, 300 RPM.

900 KVA Fairbanks-Morse, 2400 volts, 257 RPM.

625 KVA General Electric-Busch-Sulzer, 2400 volts, 180 RPM.

375 KVA Fairbanks-Morse, 2400 volts, 300 RPM.

250 KVA Westinghouse-General Motors, 240 volts, 1200 RPM.

SPECIAL
NEW 2500 KVA TURBINE GENERATOR UNITS
3 Phase 120-240 Cycle

3—2500 KVA General Electric Generators, 3 phase, 120/180/240 cycle, 480/2300/4150 volts, direct connected to General Electric Automatic Extraction Condensing Turbines, 400/600# steam pressure, 100/150# extraction pressure.

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MOTORS - M.G. SETS - CONTROLS

AT REDUCED PRICES!

NEW SLIP RING
2—New 500 HP, 1200 RPM Elliott, 220/440 V., 3 Ph., 60 Cy., Shaft 4½" dia. x 8" long. (Photo right.) Control Available.

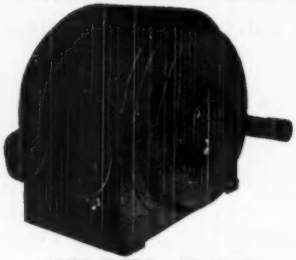
M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	250	2200	G.E.
400	125/250	2300	Ideal
300	125/250	440/2300	Allis (New)
200	250	2200	Whse.
200	125/250	2200	G.E.
150	250	440	G.E.
125	125/250	2300	G.E.
100	250	220/440	Star (New)
75	250	440	Allis
60	250	220	G.E.
30	250	440	Ideal
7½VS	250	220/440	Rel (New)

Reconditioned and guaranteed

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
900	150	440	G.E.	80%
650	138	2300	Whse.	Engine
500	514	440	E-M	100%
400	900	2300	Whse.	80%
400	720	440	G.E.	80%
350	200	2300	Whse.	100%
300	720	440	Whse.	80%
250	600	4160	E-M	100%
250	514	2300	A-C	90%
150	900	2300	G.E.	100%
150	1200	440	G.E.	80%
75	900	220	E-M	80%



SLIP RING — R & G.

HP	RPM	Volts	Mfg.
1500	514	2300	A-C
800	514	2300	Whse.
700	720	2300	Whse.
500	450	2300	G.E.
450	514	440	Whse.
400	720	2300	G.E.
350	450	2300	Whse.
300	900	440	G.E.
300	600	440	G.E.
200	1200	440	G.E.
200	720	2300	Elliott
150	1200	2300	G.E.
50	720	220	Whse.

NEW SLIP RING CONTROLS
6—250 HP 440/3/60 Fully Magnetic, Reversing, 7 steps acceleration, Allis-Chalmers, with air ckt. brkr. Open or enclosed.

NEW DIRECT CURRENT

230 Volt Drip proof — ball bearing

Qu.	HP	RPM	Mfg.	Frame
3	3	690/2660	G.E.	284
12	5	850/1700	G.E.	CD-66
5	7½	575/1750	G.E.	CD-77
1	10	575/2300	L.A.	4051
3	10	1750	Rel.	T-34
2	30	850/1700	Rel.	T-230
5	250	1750	A-C	149

Reconditioned and guaranteed
230 VOLTS D.C.

HP	RPM	Mfg.	Brg.
250	400/1200	E-D	Ball.
200	400/1200	Rel	Ball.
150	350/1200	Whse.	Ball.
100	475/1350	E-D	Ped.
75	500/1500	C-W	Sleeve
50	400/1200	G.E.	Sleeve
50	350/1050	Whse.	Ball.
40	400/1600	C-W	Ball.
30	400/1200	Rel (TEFC)	Ball.
30	700/1400	Rel (TEFC)	Ball.
25/30	500/1500	Rel	Ball.
25	690	Rel	Ball.
25	400/1600	Rel	Ball.
20	300/1200	Rel	Ball.
15	575/1000	Rel	Ball.
15	700/1350	Rel	Ball.
10	600/1200	Rel (TEFC)	Ball.
10	850	Rel	Ball.
7½	400/1600	Rel	Ball.
7½	600/1800	Rel (TEFC)	Ball.
7½	200/1200	Whse (TEFC)	Ball.
5/7½	400/1600	Whse	Ball.

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DIESEL GENERATOR PLANTS

COMPLETE WITH SWITCHBOARDS

1000 KW to 100 KW

STATIONARY and PORTABLE

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330 KW, 250 Volt DC, General Electric type HCC, 3 phase 60 cycle AC with 4160 volt primary transformers. "Excellent Condition."

THE MOTOR REPAIR & MFG. CO.
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1—2500 Ampere, 9 Volt, Munning and Munning Rectifier.

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1400 N. 6th St. Phila 22, Pa.

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NEW TRANSFORMERS
OIL COOLED
AIR COOLED
PHASE CHANGERS

ARROW TRANSFORMER CO., INC.
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GArfield 5-0433

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REWOUND
REBUILT
RECONDITIONED

35, 75, 100, 150 H.P. Self-contained Boilers
100 H.P. 125# Never Used H.R.T. Boiler
250 & 200 H.P. Slow Speed S. Rg. Motors
150 H.P. 900 & 1800 R.P.M. Sq. Cage Motors
6'x40' Louisville Dryer—excellent
2—286 H.P. Scotch Marine 150 # Boilers
100'x5' Steel Stack—very good cond.
H. & P., 6719 Etzel, St. Louis 14, Mo.

Reliably Rebuilt Electrical Equipment

41st YEAR

SPECIALS

1000 KW GENERAL ELECTRIC 250 Volt Synchronous Motor Generator Set, 900 RPM, Generator Type MCF, Motor Type TS.85% T.F. 3 Phase 60 Cycle 2300/4000 Volts.

Factory Built Unit

Rebuilt — 1 YEAR GUARANTEE

PARTIAL LISTINGS ONLY

MOTORS
Squirrel Cage 3 Phase

H.P.	Make	Type	Speed
450	G.E. (vert.)	KF-6838	1180
200	G.E.	KT557	1750
200	Wagner	RP2	1750
200	G.E.	KF-6335	880
150	West.	CS	580
125	Al. Ch. (2)	AR	435
100	Wagner New	XP	1150
100	G.E.	K-544	1175
100 *	West.	CS	870
100	Al. Ch.		580
75	West.	CS	1750
75	G.E. (3)	K-505	1175
75	G.E.	IK	900
75	G.E. (3)	KT-352	865
75	West.	CS	720
75	G.E.	K-356	690
75	G.E.	KT-558	580
60	F-M	Tot. Enc.	1800
60	West. (2)	CS-607	880
60	Rel. (2)	AA	875
60	G.E.	KT-346	865
50	G.E.	FTR-523	3600
50	Elliott	196	3450
50	West.	CS	1740
50	L.A. (3)	XP	1150
50	West.	XP	1150
50	G.E.	KF-445	1170
50	West.	CS-642C	1160
50	West. (3)	CS	870
50	G.E. (2)	IK	870
50	G.E.	FTR-542	870
50	West.	CS	690

MOTORS
Slip Ring 3 Phase

H.P.	Make	Type	Speed
600	Cr. Wh.	131AQ	507
500	G.E. (2)	IM	450
400	West.	CW	514
225	Wagner	25 cy.	710
200	G.E.	MT559	1150
200	G.E. (2)	IM	1170
150	Wagner	31VRN	900
100	G.E.	MT-553	1165
100	Al. Ch.		690
65	West.	CW	1150
65	G.E.		690
50	West.	HF	850
50	Al. Ch.		690
50	G.E.	MT-536	1150
50	West.	CW	1150
50	G.E.	MT-336	1150
50	L.A.	OGH	870
50	F-M	BV	600
50	Al. Ch.	ARY	575
50	G.E.	IM	490

MOTORS
Synchronous

H.P.	Make	Type	Speed
475	West.		720
400	G.E. (2)	TS-928S	600
300	G.E.	ATI	900
260	G.E.	TS	900
200	Ideal	SMW	257
200	G.E. (2)	TS	1200
150	G.E. (2)	TS	1200
180	G.E.	ATI	900
150	G.E.	TS	1200
145	G.E.	ATI	720
135	West.	G	1200
135	Ideal		1200
100	G.E.	TS	1200
55	El. Mchy.	BRKT	1200

MOTORS
550V. D.C.

H.P.	Make	Type	Speed
765	G.E. (6)	MPC	1045/1350

MOTORS
230V. D.C.

H.P.	Make	Type	Speed
400	A-C		415
135	C-W	CCM152H	233/900
125	G.E.	RC-15	1750
100	Al. Ch.		1150
90/45	G.E.	RF-17	950/475
75	Sprague		1000/1500
75	West. (2)	SK-180	475
75	Cr. Wh.	LT	480/670
75	Cr. Wh.	CMC	375/950
75	West. (3)	SK151	250/1000
60	West. (3)	SK-160	680
50	G.E.	RC-12	1750
50	Diehl		850/1050
45/90	G.E.	RC-17	475/1950
50	West. (3)	SK-160	565
50	G.E.	RF-17	250/1000
50	West.	SK	250/1000
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G.E.	RC-31	1700
40	G.E.	RC-32	1100
40	G.E.	RC-34	750
40	G.E. (2)	CD-1441	400/1500
40	Cr. Wh.	CCM	700
40	Rel.	461T	400/1200
35	West.	SK-120	1150
35	G.E.	RLC	440/800
30	G.E. (8)	CDM-85	2200
30	West.	SK	975
30	Cont.	D-103	850
30	G.E.	RC-33	775
30	West.	SA	500/1500
30	West. (2)	SK-143	575
25	G.E.	RC-15	1750
25	West.	SK-83	1750
25	G.E.	CDM-77	1750
25	E.D.	10S	1500
25	Rel.	92T	1150
25	West.	SA	500/1500
25	West. (2)	SK-130	600
25	G.E.	RF-14	300/1200

MOTORS
115V. D.C.

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr. Wh.	CMC	900
40	G.E.	CD-113	850
30	West.	S	600
25	G.E. (2)	CD	1800
25	West.	SK-103	1150
25	Cr. Wh.	CCM	750
25	West.	SA	600/1200
15	E.D.	7½S	650/1250
15	Cr. Wh.	CM	650
12½	G.E. (3)	CDM-85	930/1160
12½	G.E.	*CDM-95	930/1160
10	Century	DN-334	1750
10	G.E. (2)	RC	1200
10	Al. Ch.		900
10	E.D.	7½S	425/1700
10	Diehl		230

GENERATORS—A.C.
Driven by D.C. Motors

KVA	Make	D.C. Input	A.C. Output
288	West.	115	450
75	G.E.	230	240
50	Star	115	120
35	G.E.	230	220
31	Ideal	115	440
31	El. Mchy.	230	440
18	G.E.	230	120/240
10	Burke	115	120
7½	Hertner	115	440
5	El. Spec.	115	110
1¼	Al. Ch.	230	110

GENERATORS—A.C.

KW	Make	Type	Speed
216	West.	G	900
180	G.E.	ATB	900
100	G.E.	ATB	360
75	G.E. (2)	ATB	1200
50	F-M	GG	1200
15	G.E.	ASI	1200

Frequency Changers and Generators

Size	Make	Output Frequency
150 KW	G.E.	150 cy.
154 KVA	G.E.	150 cy.
50 KW	G.E.	120 cy.
40 KW	G.E.	100 cy.
30 KW	G.E.	90 cy.
15 KW	G.E.	408 cy.
10 KW	G.E.	200/700 cy.
7½ KW	G.E.	408 cy.
3 KW	G.E.	408 cy.

GENERATORS
600V. M D.C.

KW	Make	Speed
400	G.E. (4)	1200
150	G.E.-RC (2)	1150
100	West.-SK	900
75	West.-SK	1150
60	G.E.	1200
30	Burke	1750
25	Reliance	1150

GENERATORS
250V. D.C. Motor Driven

KW	Make	Speed
1000	G.E.	900
500	West. (2) Rotary	1200
300	Elliott	1200
300	G.E. (3)	720
200	G.E.	1200
150	West.	900
100	Delco	1200
75	G.E.	1200
50	G.E.	1200
40	Rel. (4)	1750
42	ABC (2)	1200
30	G.E.	1200
25	G.E.	1200

GENERATORS
125V. D.C. Motor Driven

KW	Make	Speed
250	G.E.	720
150	Cr. Wh.	1200
150	West.	1150
100	West. (2)	900
100	G.E.	1200
100	El. Mchy.	1200
75	Cr. Wh.	1200
75	Hertner	1150
50	West.	1150
50	Cr. Wh.	1150
50	Sturt.	2800
35	Ideal	1200
30	G.E.	1150
30	L.A.	1450
25	El. Mchy. (2)	1150

GENERATORS
Low Voltage D.C.

Amp.	Make	Voltage
5000	Optimus	6/12
1500	H-V-W	6/12
125	Hobart (8)	7½
1000	G.E.	15
750	Master	20
1500	Century	24
3000	El. Prod.	24
550	Col.	27
100	G.E.	30
1000	G.E.	33
150	Watton	40
1000	Chandy (3)	40
200	G.E.	42
1500	G.E.	50
1500	Century	60
1500	G.E.	60
1000	G.E.	75

TRANSFORMERS

3—500 KVA Pittsburgh 13200/480.
1—300 KVA, Al. Ch. 3 ph, 41600V. Primary, 230V. Secondary.
1—300 KVA, Pittsburgh, 3 ph, 41600V. Primary, 230V. Secondary.
8—100 KVA West. 3 ph. 440-220 Dry.
2—50 KVA G.E.—11—KF, 2400/4160V—120/240V. Sec.
4—25 KVA West. 440V. Primary, 110/220V. Sec.
—15 KVA West. 440V. Primary, 110/220V. Sec.
60—Additional Oil and Insulated Dry-type Transformers In Stock, not listed, down to 1 KVA.

STARTERS—A.C.

1—450 H.P. West. magnetic reduced voltage (550 V.) Synch.
2—400 H.P. C-H Bulletin No. 9976, 440V. magnetic reduced voltage Synch.
1—250 H.P. C-H Bulletin No. 9589, 4150V.
1—200 H.P. G.E. CR-7065, 440V. Synch.
3—150 H.P. G.E. CR-7061, 220V. Synch.
2—100 H.P. C-H full voltage Synch.
40—C-H and A-B, 2 and 4 speed magnetic starters.
635—7½ H.P. C-H 440V. magnetic starters.

STARTERS—D.C.

1—600 H.P. 230V. West. magnetic.
150—New 230V. D.C. magnetic starters, from ½ H.P. to 75 H.P., C-H, G.E., etc.
100—New 230V. D.C. manual starters from 1 H.P. to 5 H.P.—G.E. and C-H.
40—New 7½ H.P. 230V. magnetic reversing.
1—300 H.P. West. 230V. magnetic.
Over 250 additional D.C. starters in stock, not listed, all sizes and voltages.

EST. 1910 — L. J. LAND INC. — 41st YEAR

156 GRAND STREET — Phone CAnal 6-6976 — NEW YORK 13, N. Y.

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ELECTRIC POWER EQUIPMENT

GET A-1 PERFORMANCE—SAVE 40 TO 70% IN PRICE

SQUIRREL CAGE MOTORS

3 phase, 60 cycle—220 or 440 volt (*2200 volt or higher)

H.P.	Make	Type	Speed
750	G.E.	KT	720
500	G.E.	KTP-587	1250
400	*Al. Ch.	ANW	900
300	G.E.	FT-559A	1800
250	Westg.	CS-958A	880
200	Reliance	AA-C60858	1200
200	*G.E.	IE-15-K	1200
150	Westg.	CS-771	1800
150	G.E.	IE-13AK	1800
150	G.E.	IE-13B	1200
150	G.E.	I-15-B	900
150	Westg.	CS-950A	600
125	G.E. TEFC	K-6328B	1200
100	U.S.-Vert.	CFU-994-A	1200
100	Burke	EM-12-S	1200
100	G.E.	K-6333	720
75	Westg. New	CS-505-S	1800
75	Westg.	CS-761	1800
75	G.E.	FTR-543-S	1200
75	G.E.	KT-347	1200
75	G.E.	K-505	1200
75	*G.E. Vert.	CS	900
75	*G.E.	I-10-K	720
75	G.E.	FT-558	720
75	Al. Ch.	AN	720
75	*Triumph	TR-16	514
60	G.E. NEW	K-448	1800
60	G.E. NEW	K-504	1200
60	G.E. NEW	K-504U	1200
60	Al. Ch.	ARA-826F	514
50	Al. Ch.	AR-445	1800
50	G.E.	KF-4052	3600
50	G.E.	KT-327	1800
50	Westg.	CS-640	1800
50	G.E. TEFC	K-444	1800
50	G.E.	KT-343	1200
50	Burke	EM-7	900
50	G.E.	KT-340	900
50	G.E.	IK-13	900
40	*Al. Ch.	ARX-445	3600
40	G.E.	KF-4045	3600
40	Westg.	CS-640	1800
40	G.E.	KT-332	1200
40	Al. Ch.	AR-594	900
40	G.E.	KT-338	900
40	G.E.	KT-343	720
38	Howell	HBB-328	3600
30	Westg.	CS-405	1800
30	G.E.	K-444	1200
30	Al. Ch.	AR-204	900
25	Cr. Wh.	115Q	1200
25	Westg.	CS-556A	1200
25	G.E.	KT-332	900
25	Al. Ch	AR-220C	900
20	Westg.	CS-364	1800
20	G.E.	KT-3015	1800
20	Louis Allis	XL-835	1200
20	G.E.	KT-312	1200
20	Westg.	CS-464-C	1200
20	Westg.	CS-644	900
20	G.E.	KT-328	900
15	Westg.	CS-328	1800
15	G.E.	KT-312	1200
15	G.E.	FRT-502	1200
15	Westg.	CS	900
15	G.E.	KT-322	900
15	G.E.	KT-332	720
10	G.E.	KT-181	3600
10	G.E.	KT-181	1800
10	Howell	SC-310	1800
10	Cr. Wh.	SC-60	1800
10	G.E.	KT-752	1200

H.P.	Make	Type	Speed
10	G.E.	KT-956	1200
10	G.E.	KT-902	900
10	G.E.	IK	720
10	G.E.	KT-328	900
7½	G.E.	KT-994	1800
7½	Westg.	CS-2500	1800
7½	Cr. Wh.	114-Q	1200
7½	G.E.	KT-958	900
7½	Commonwealth	P-405	514
7½	G.E.	KT-528	450
5	Star	AX-45	3600
5	G.E.	K-254	1800
5	Cr. Wh.	SC-254	1800

SLIP RING MOTORS

3 phase, 60 cycle—220 or 440 volt (*2200 volt or higher)

H.P.	Make	Type	Speed
2500	*G.E.	MT	257
2000	*G.E.	MT-38	240
1250	*G.E.	M	720
1200	*G.E.	MT-28	277
800	*Westg.	CW	807
650	West.	HE	360
500	Westg.	CW	360
500	Westg.	IE	1800
400	G.E.	CW	450
300	*G.E.	IEISA-4	1800
300	G.E.	IM-17	1200
250	Westg.	CW-32B	900
250	Westg.	CW	600
200	G.E.	IM	600
150	Al. Ch.	ANY	600
100	G.E. NEW	M6333Z	900
100	G.E. NEW	M6334	720
100	Westg.	CW-856C	600
100	G.E.	IM-15A	450
75	G.E.	IM-E-4	1800
75	Westg.	CI-756A	600
75	Cr. Wh.	25Q	600
75	G.E.	IM-14	514
60	*Westg.	CW-762C	900
50	G.E.	IM-11A	1800
50	G.E.	MT-346-B	900
50	Westg.	CW-636A	1200
50	*Al. Ch.	ARY-220BS	1800
50	G.E.	IM-14	425
50	G.E.	MT-343	1200
50	G.E. NEW	M-502	1200
40	Westg.	CW-644C	900
37	G.E. TENV	HITC-5012	600
35	G.E.	IM-8	1200
35	Fr. Bros.	UAB-1M12D	1800
30	G.E. NEW	M504-U	900
25	Westg.	CI-572A	900
30	G.E.	MT-332	1200
25	G.E.	IM-11	1200
25	Al. Ch.	ARY-220C	900
20	Al. Ch.	ARY-216D	1200
20	Westg.	CI	900
20	G.E.	IM-12	600
20	Westg.	CW-644C	600
20	G.E.	MT-322	900
20	G.E.	MT-503-4	1800
15	G.E.	MTG-9336	1200
15	G.E.	IM	1200
15	G.E.	IM	900
15	Westg.	CW	900
15	Al. Ch.	ARY216D	900
15	G.E.	ITC-5010	720
10	Al. Ch.	ANY	1200
10	Westg.	MW-386	1200
10	Al. Ch.	ARY-216C	900
7½	G.E.	MT	1200
6½	Rob. Hoy.	425A	1200

2 COMPLETE VARI-VOLT DRIVES

M.G. Set, 200 K.W., D.C. gen., Elec. type MPC, 250 volts, 800 amps. 1200 RM. dir conn. to 300 HP syn. motor, Gen. Elec. type TS. 3 ph. 60 cy. 440 volt, .8 PF, 1200 RPM

D.C. Motor, 250 H.P., Gen. Elec. type MPC, 245 volt, 730/975 RPM, with complete starting and control panels.

MOTOR GENERATOR SETS

K.W.	Make	A.C.	D.C.
1000	G.E.	4000	275
500	G.E.	2300	230
500	G.E.	440	230
500	G.E.	4000	1200
450	G.E.	2300	250
200	Cr. Wh.	2300	125
200	G.E.	440	250
150	Al. Ch.	220	125
100	G.E.	440	250
75	Star	440	230
75	G.E.	440	250
60	Al. Ch.	2300	110
60	Fr. Morse	220	125
50	Westg.	220	110
40	Cr. Wh.	220	125
25	G.E.	440	250
20	G.E.	440	250
20	G.E.	440	125
15	Ideal	220	125
10	Cr. Wh.	220	125
10	Ideal	220	125

LOW VOLTAGE—M.G. SETS

Amp.	Make	A.C.	D.C.
1500	Chandyn	440	80
1500	G.E.	2300	60
1000	Chandyn	440	40
333	Columbus	440	45

BALANCING SETS

4—34 K.W., 250 V., 270 A. neu. Regue, type MCI, 125 V. gen. BB comp'd d/c on fab base

2—20 K.W., 250 V., 160 a. neu. Cr. Wh. type 151, 125 V gen 3 sl. brg. Close coupled.

SYN. A.C. MOTORS

3 phase, 60 cycle—220 or 440 volt (*2300 volt or higher)

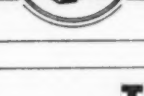
H.P.	Make	Type	P.F.	Speed
1000	*Westg.	SC-3D358	.8	900
700	*G.E.	ATI	.8	720
450	El. Mach.		1.0	240
320	*Al. Ch.	Dr. Prf	1.0	720
250	*Al. Ch.		1.0	720
200	*Al. Ch.		1.0	900
150	G.E.	ATI	.8	600
125	G.E.	TS-954B	1.0	1200
100	Cr. Wh.	100-S	.8	900
100	G.E.	ATB	.8	900

A.C. GENERATORS

3 phase, 60 cycle—220 or 440 volt (*2300 volt or higher)

H.P.	Make	Type	P.F.	Speed
1000	*Westg.	803D	.8	900
725	*G.E.	ATI	.8	720
250	*Al. Ch.		.8	720
150	G.E.	ATI	.8	600

First Source for 40 Years for Quality Electrical Equipment



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USED BOILERS

3—10,000' American Red Flash heating
1— 30 HP Scotch Marine, 100# hand fired
4— 90 HP locomotive fire box 200#
4—110 HP locomotive fire box 200#
2—150 HP locomotive fire box 150#
1—250 HP B&W water tube 170#
2—150 HP H R T 150#
1—410 HP Heine water tube 200#
1—505 HP Brise water tube 200#
1000 AC 220 Turbine Generator

NATIONAL BOILER & EQUIPMENT CO.
1501 So. Senate Ave., Indianapolis 25, Ind.

STEEL STORAGE TANKS

2—1000 & 2—10,000 Bbl. New Vertical
6—74,000, 55,000 & 37,500 Bbl. Vert.
8—25,000 Gal. Cap. Horizontal
50—10,000 & 3—20,000 Gal. Horizontal
6—10,000 & 12,000 & 16,000 Gal. ⅜" Shell
20—10,000 Gal. Cap. 60 lbs. Press. Test

L. M. STANHOPE, Rosemont, Penna.

FOR SALE

MODERN 1000 KW Turbo-Generator

in Excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

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- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular suppliers.
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MOTORS
GENERATORS
TRANSFORMERS
1 to 1500 H.P.

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ROCHESTER 1, NEW YORK
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TRANSFORMERS

FOR SALE

2— 150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6— 100 KVA. 60 CY. 1 PH. 2400-240/120.
6 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

ATLANTIC TRANSFORMER CO.
5143 N. 2nd St. Philadelphia 20, Pa.

BOILERS

10 to 5000 H.P.
Diesel, Steam Turbine, Engine

GENERATORS

Heavy Power Equipment
Industrial — Chemical Process Equipment

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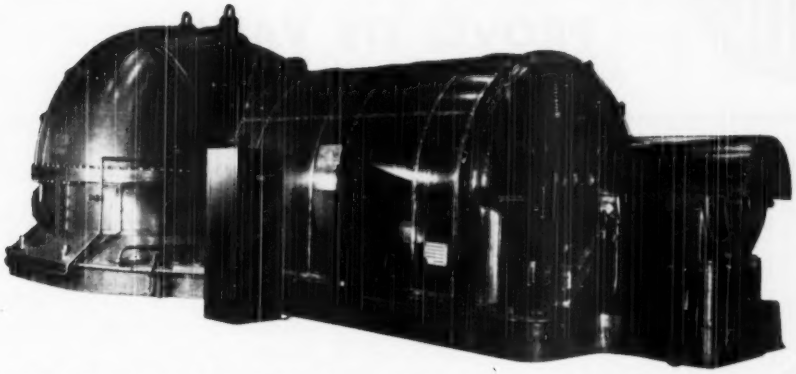
with "UTILITIES APPROVED" EQUIPMENT



25,000 KVA M—20,000 KW, 80% P.F., 3 phase 60 cycle, 13,200 volts, 1800 RPM General Electric Company condensing turbine generator unit 200-215 P.S.I.G., 540° total temperature complete with direct connected shaft exciter, switchboard and instruments, a 30,000 sq. ft. 2-pass Westinghouse surface condenser, motor driven and turbine driven pumps and condensing accessories.

EXCELLENT CONDITION — COMPLETE INSTALLATION — PROMPT DELIVERY

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

6250 KVA G.E. condens., 3-stage, 2300/4000 volts, 200# P.S.I., 600°TT.

3125 KVA G.E. condens., 150#, 550 volts.

2500 KVA G.E. Type ATB, Form HT, 2300/480 volts, 3600 RPM, two bearing alternating current generator LESS TURBINE.

937½ KVA Allis condensing 250 P.S.I., 700° total temperature, 480/600/2400 volts.

625 KVA G.E. non-condensing 150 P.S.I. 20# back, 480 volt.

625 KVA G.E.—Murray condensing 250 P.S.I., 2300 volts

375 KVA (4) G.E. condensing 400# pressure, 480/600/2300/4150 volts.

125 KVA G.E. non-condensing, 150-200 P.S.I., 2300 volts.

125 KVA Westghse. non-condensing 150/250 P.S.I. 2400 volts NEW

100 KVA Westghse. non-condensing 125-150# P.S.I. 10# gauge back, 2400 volts.

Direct Current

300 KW Westghse. 3-wire, 250 volt 150/250# P.S.I. non-condensing

150 KW (2) Westinghouse-Worthington, 250 volts, 3-wire, 225-250 P.S.I. condens.

100 K (2) G.E. 125 volt, 200/275 P.S.I. non-condensing

75 KW Allis-Chalmers-Terry, 125 volts, 2400 RPM 150# P.S.I. non-condensing.

75 KW (2) Westinghouse-Moore, 120 volt, 200# P.S.I. condensing.

60 KW (3) new Westinghouse, 120 volt, 200# P.S.I. condensing.

MOTOR GENERATOR SETS

500 KW (3) G.E. 6 phase, 60 cycle—600 volt direct current 1200 RPM rotary converters.

150 KW G.E., 125 volt direct current generator direct connected 225 HP, 3 phase, 60 cycle, 220 volt, 1200 RPM synch

100 KVA Westghse. 60 cycle, 2400 volt, 900 RPM alternator direct connected 135 HP, 220 volt direct current motor.

62½ KVA G.E., 60 cycle, 2300 volt alternator to 75 HP, 125 volt DC motor.

NOVEMBER BARGAINS

1—4400 sq. ft. Worthington surface condenser.

4—900 KW, 250/375 volt direct current generators connected 1200 HP, 720 RPM Fairanks Diesel Engines.

1—5425 GPM, 70 foot head Centrifugal pump connected 125 HP 60 cycle, 2200 volt, 1750 RPM G.E. motor.

2—1000 GPM, 1270 foot head, 4-stage Morris pumps each connected 417 HP, 390# P.S.I. non-cond. G.E. turbine.

1—G.E. Bank of Scott connected 2 to 3 phase, 60 cycle transformers, 2500 KVA capacity.

2—20 KW, 125 volt Allis direct current generators each connected Hill Diesel engines.

UNAFLOW GENERATOR UNITS

Alternating Current—3 phase, 60 cycle

750 KVA G.E., 2300/575 volt generator connected Skinner Vertical non-condensing engine, 150-175# P.S.I.

675 KVA G.E. 2300/480 volt generator connected horizontal engine.

625 KVA 40°C Rise, General Electric, 240 volts generator connecting Skinner non-condensing engine. 150 P.S.I.

500 KVA G.E., 2400/480/240 volts generator connected Ames Engine, 150#.

375 KVA G.E., 2300/440 volts generator connected 23"x24" Skinner Horizontal Engine, 125 P.S.I.

175 KVA Westghse., 240 volt generator connected Skinner Horizontal Engine, 125-150# P.S.I., 5# gauge back.

Direct Current

400 KW G.E. 250 volts, 380 RPM generator connected Skinner vertical engine 150#.

275 KW Westinghouse, 250 volt generator connected Ames vertical engines, 150#.

250 KW (2) G.E., 3-wire, 250 volts generators connected Skinner engines, 150#.

150 KW Westghse. 3-wire, 250 volt generator connected Ball Engine, 150#

SYNCHRONOUS MOTORS

3 phase, 60 cycle

5000 KVA Westinghouse, 4000 volt, 720 RPM Electrical Synchronous (condenser).

900 HP Allis, 2200 volts, 150 RPM.

300 HP G.E., 80% P.F., 2300 volts, 720 RPM.

UMC UTILITIES MACHINERY CORP.

1965 EAST 6th STREET • CLEVELAND-14, OHIO • Long Distance 422

Our 30th Year

HEMPHILL EQUIPMENT PROVES ITS VALUE

Member of The National Industrial Service Association, Inc.

TRANSFORMERS—60 Cycle

Qu.	KVA	MAKE	TYPE	Ph.	VOLTAGES
1	1000	GE	Pyranol	3	4150 x 2400
1	1000	GE	Auto	3/2	4150 x 2406
1	1000	GE	Auto	3	3810Y-2300Y
1	500	Kuhl.	OISC	1	4600 x 2300V
3	400	GE	H	1	6900 x 2250V
1	300	Pitts.	ODSC	1	7800 x 440V
3	300	GE	H	1	2400 x 120/240
1	200	Whse.	Auto	3/2	4150 x 2300
1	200	Pitts.	OISC	1	4000 x 110/220
1	200	GE	Auto	3/2	4150 x 2400
1	150	GE	KS	1	2300 x 230
1	100	Pitts.		1	2750 x 110/220
3	100	Wagner	RCKV	1	240 x 120/120
2	100	Whse.	SK	1	4400 x 220/440 Taps
2	100	Newark	Dry	3/2	440 x 220

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

Qu.	KW	MAKE	SPEED	DC	AC
2	1500	GE	600	275	4000 Syn.
1	1000	GE	514	600	4000 Syn.
1	1000	GE	514	600	2300/4150 Syn.
1	500	GE	900	275	2300/4150 Syn.
1	400	GE	900	275	2300/4150 Syn.
1	300	GE	1200	250	2300 Syn.
2	150	GE	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	2300 SC
1	100	CW	1200	125	220/440 SC
1	100	El.Mach.	1200	125	4150 Syn.
2	75	GE	1200	125	220/440 SC
6	75	GE	1200	60	220/440 SC
1	50	Ridgeway	1200	550	220/440 SC
1	50	Whse.	900	250	220/440 SC
2	40	El.Mach.	1750	125	440 SC
1	35	Ideal	1200	125	220/440 SC

SLIP RING

1	2500	GE	MT	6600	287
1	500	GE	MT	2200	720
1	300	Whse.	CW	440	600
1	250	Whse.	CW	440	600
1	200	Whse.	CW	440	600
1	100	GE	IM	440	400
1	75	GE	MT	220	1200 Vert
1	75	GE	MT	440	900
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1720
1	50	GE	MT	220	1200
1	50	Whse	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	600
1	40	GE	MT	220	1200
1	40	GE	MT	2200	1200

J. L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.
PHONE NEW YORK — LONGACRE 5-3227
PHONE NEW JERSEY — UNION 3-2600

This Seal is *Your Guarantee*

Quality SINCE 1906 — Wente Motors — WIDE SELECTION UNUSUAL VALUES

THEIR ELECTRICAL CONSTRUCTION HAS BEEN REBUILT... BY EXPERTS

SQUIRREL CAGE
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	G.E.	I (2300 V.)	900
2	50	Al. Ch.		900
1	60	G.E.	KT Vert.	1800
4	60	G.E.	KT (2200 V.)	1200
4	60	G.E.	KT547Y (2200 V.) SP	1200
1	60	West.	CS (TEFCBB)	1200
1	75	West.	CS (TEFCBB)	1200
1	60	West.	CS Gearhead	332
1	100	G.E.	KT (2200 V.)	900
4	100	G.E.	K (TEFCBB)	1200
1	110	G.E.	KTP	1200
1	120	G.E.	FT	3600
3	125	Al. Wh.	AR (BB)	450
2	150	Al. Ch.		1750
1	250	G.E.	KF (Vert.)	3600

SLIP RING—SYNCHRONOUS
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

1	50	Ideal	AV	600
1	50	G.E.	I	760
1	60	Ideal	AVX	1200
1	70	KW G.E.	TS (.7PF)	1200
1	75	West.	CW	400
1	75	G.E.	I	520
1	75	Fr.Morse	BV (2200 V.)	1800
4	100	G.E.	I-16 (2200 V.)	450
1	100	KW G.E.	ATB (.8PF)	900
4	100	G.E.	MT546Y(2200V.)SP	450
1	100	G.E.	MT556	900

Qu.	HP	Make	Type	Speed
1	125	Fr.Morse	T (2400 V.) (PF1.0)	900
1	150	West.	CW	450
1	200	West.	CW (3 Bear.)	600
1	625	Kva E.M.	(.8 PF)	900

D.C.—230 VOLT
(Other voltage as noted)

1	50	West.	SK	350
3	50	Reliance	T	2700
1	50	West.	SK (115 V.)	500
1	60	West.	SK (115 V.)	500/1500
1	75	Diehl	K11	700
2	75/100	Reliance	T1050	300/900
3	75	West.	SK, frame 183	850
1	100	West.	SK, frame 160	1200
1	100	Cr. Wh.	CM	600
1	130	Cr. Wh.	CMC (550 V.)	1200
1	150	West.	SK	400/1200
1	150	West.	SK	350
1	200	Cr. Wh.	CMC	450
2	200	Reliance	T2550	300/900
2	200	G.E.	TLC-74	1350/4000
1	250	West.	SK	1050

M-G SETS

1— 45 KW West. 60 V DC—440 V AC 1200 RPM
4— 60 KW G.E. 60 V DC—440 V AC 1200 RPM
2— 75 KW El. Prod. 220 V DC—440 V AC 1200
1—100 KW West. 250 V DC — 440 V AC 1200
1—100 KW West. 250 V DC — 440 V AC 900
1—100 KW Reliance 250 V DC — 220 V AC 1200
1—100 KW Ridge 275 V DC — 440 V AC 1200
1—150 KW G.E. 275 V DC — 440 V AC 900

ALSO—4000 motors other than listed from 1 HP to 300 HP.

The Wente Electric Co., Hamilton — 203 NO. FOURTH ST. — Phone 4-8128 — Ohio

TWO STOKERS, COMPLETE

Detroit Overfeed Rotostoker—double feed. Capacity: 500 boiler H.P. Grate area: 45 sq. ft. Grate dimensions: 6 ft. x 7 ft. 6 in. Stokers complete with forced draft fans. Stoker parts: 4 feed units, 2 drive units, 2 blower fans, 2 wind tunnels, 2 set grates, 2 boiler fronts for mounting feed units.

PURITY BAKERIES
97 E. 12th St. — St. Paul 1, Minn.

500 HP Bros W.T. Boiler, Bros Sprdr. stkr. $7,000
500 HP Vogt W.T. Boiler, Flrite Spr. stkr. $7,000
260 HP Vogt W.T. Boiler, Westghse Undf. " $4,500
216 HP Vogt W.T. Boiler, compl. new tubes $3,500
2—150 HP HRT boilers, shell only, $750 & $1,000
Westghse Underf. stkr. 114' gr., prac. new, $2,000

ALLIED EQUIPMENT COMPANY
Louisville, Ky.—950 Cherokee Rd., HI 2138
Woodside, L.I.—4205 48th Ave., IR 6-8776

DIESEL ENGINES

240 H.P. Fairbanks-Morse style VA, 4 cylinder vertical diesel engines, one 250 KVA alternator and one 260 KVA alternator. These units are complete with 10 KW excitation generators, gasoline motors and tanks for starting, cooling tower and auxiliary equipment, switchboard, governors, complete units are now operating and in good condition.

For Complete specifications and details write:

ALBERS MILLING COMPANY
5045 Wilshire Blvd.
Los Angeles 36, California
Attn: W. G. Fisher

GENERATOR SETS FOR SALE

Cummins Diesel 6 cylinder 100 H.P. electric starter radiator cooled RPM 1200 45 K.W. 2300 volt direct-connected generator exciter attached. Excellent condition, not much wear was used as standby only.

360 K.W. generator unit 2300 volt Chuse Rotary valve steam engine size 23x28 belted exciter 175 RPM. Good buy, see it perform.

Steam generator unit powered by Chuse steam engine equipped with Baker Piston valve direct connected generator 120 K.W. 2300 volt 225 RPM exciter mounted direct on engine shaft. See it perform.

Phone Garfield 4486
or write
JOHN WACHTEL CORPORATION
Box 1217, Indianapolis 6, Indiana

COMPLETE DIESEL PLANT

3—700 HP Winton 8 cyl. 4 cycle, 360 RPM diesels. 500 KW Elec. Mchy. 3/60/2300 alternators. Switchboards and complete plant auxiliaries. For sale in whole or part. Condition excellent.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

The Stephen A. Douglass Co.

Condensing & Non-cond.:
TURBO-GENERATORS
Efficient, High Grade
Boilers to meet your needs
Diesel Electrics
all with LOW capital cost.

? *On what capacity units shall we quote you* ?

All types Power Equipment also.
630 Fort Washington Ave., N. Y. 33, N. Y.

SPECIALS

600 KW Nord. Uniflow Plant. 575 KW Coop. Bess. Oil—Gas—Ideal Diesel Gen. Unused. Comp. Eng. Access. & Exciter.

POWER EQUIPMENT

MERRILL and COMPANY
407 So. Dearborn St. • Chicago 5, Illinois
Telephone: HArrison 7-8289

BOILERS

10 to 1000 H.P.
NEW-USED RECONDITIONED
Steam, Gas and Electric Power Equipment
J. PARKER THOMPSON CO., INC.
507 FIFTH AVE., NEW YORK CITY
MURRAY HILL 7-6547-8-9

FROM AVAILABLE STOCK

Rebuilt to N.I.S.A. Standards

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1800	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2200/4400
1	1250	G.E.	600	275	2200
1	1000	Whse.	900	600	2300/4150
1	1000	West.	514	250	4150
1	800	G.E.(3U)	1200	120/240	2300
1	750	Al. Ch.	720	250	220/2200
1	750	Whse.	900	250	2300
1	500	G.E.	720	125	2300/4000
2	400	G.E.	720	250	440/2300
1	400	G.E.	1200	120/240	440
1	400	G.E.	720	600	9500
1	350	G.E.	900	125	2300/4150
1	300	Whse.	1200	250	1200
1	150	Whse.	1200	275	2200
1	150	Cr. Wh.	1200	250	440
1	140(3U)	Cr. Wh.	690	125/250	2300
1	100	G.E.	1170	125	220
1	75	Cr. Wh.	1170	250	220/440
1	60	G.E.	1200	250	2300

ROTARY CONVERTERS

60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1—	2000	G.E.	514	600	13800
1—	1000	Whse.	900	600	11000
1—	750	Whse.	900	600	13200

RECTIFIERS

1— 750	G.E.	BHW	575	2300
1—1000	A.C.	B-612	625	13500
1—1000*	A.B.B.	GBZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	1000	G.E.	Condensing 135/150# ISP 2300/4150 V 3 ph. 60 cy.
2	750	G.E.	Condensing 250/275# ISP 440V, 3 ph. 60 cy. (New 1944)
1	625	Whse.	Non-condensing, 125/150# ISP, 5/20# B.P., 480 v., 3 ph., 60 cy., with exciter
1	400	Whse.	Non-condensing 125/150# ISP 5/10# BTU 40/480v, 3 ph. 60 cy.
2	400	G.E.	Condensing, 275# ISP Geared to 1200 RPM. 120/240V. D.C. Generator.
1	300	G.E.	Non-condensing 150/175# ISP 5/15# B.P. 450V. 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM 120/240V. D. C.
2	200	Cr. Wh.	Condensing 250# ISP GEARED to 1200 RPM—125V. D.C. Gen.
1	200	Whse.	Non-condensing 150# ISP 75 B.P. 240V. 3 ph. 60 cy.

TRANSFORMERS

60 Cycles

Qu.	KVA.	Make	Type	Ph.	Voltages
3	2666	Whse.	OISC	1	6600/11000
1	2500	Al. Ch.	OISC	3	13200 x 2300
3	1250	G.E.	S	1	6600 x 500
3	1000	G.E.	WCTH	3	11000 x 445
3	667	Al. Ch.	OISC	1	13200 x 230/460
1	600	Al. Ch.	OISC	3	4000/2300 x 216
3	333	Maloney	C	1	7620/13200x120/240
3	333	Fitta.	OISC	1	26400 x 2400
6	250	Whse.	OISC	1	11000 x 240
3	208	Whse.	OISC	1	7200 x 240/480
1	100	G.E.	H	1	450 x 230

D. C. MOTORS

	HP	Make	Type	Volts	Speed
1—1750		Whse.		600	525/750
1—1500		Whse.		525	600
1—1200		Whse.		600	425
1—940		Whse.	QM-B.Brg.	250	140/170
1—600/1000		Whse.		450	600/750
1—650		G.E.	MPC	250	115/145
1—600		Al. Ch.	MILL	230	400/600
1—300/400		G.E.	DYNA	250	1325/1800
1—325		Whse.	MG	250	300/900
1—300/300		G.E.	MPC	230	360/920
1—275		Whse.	QM-600-6	230	425/850
1—250		G.E.	MFC	230	400/900
1—150		G.E.		600	850/750
10—150		Cr. Wh.	83H	230	890

FREQUENCY CHANGERS

1—1000	G.E.	25/60 Cycle	2300/4150
1—500	A.C.	25/60 Cycle	11000/2300V

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	TS	2300	257
1—2100	G.E.	ATI	4600	514
2—2000	Whse.		2300	138
1—1470	Whse		4600	900
2— 900	Al. Ch.	(New)	2200	150
1— 650	Whse.	Q	2200	138
1— 600	Whse.	Syn.	440	360
1— 450	Whse.	Eng.	2200	138.5
2— 350	G.E.	TS	2200	150
1— 300	G.E.	ATI	440	720
1— 300	Whse.		2300	720
1— 300	Al. Ch.		440	600
1— 225	G.E.	ATI 1-Brg.	440	900
1— 125	G.E.	ATI	440	450
1— 100	Whse.		550	600

SLIP RING

2— 700	Whse.	CW	2300	900
1— 500	G.E.	IP	550	505
1— 500	G.E.	IM-MIII	2300	450
1— 350	G.E.	MT-442T	2300/4000	353
1— 300	Al. Ch.	3 Brg.	2300	595
1— 300	G.E.	IM	440	720
1— 300	Al. Ch.	ANT	2200	704
1— 250	G.E.	M-567-TEFC	440	600
1— 250	G.E.	MT-424T	4000	257
1— 250	G.E.	MT-559S	2200	1750
4— 125	G.E.	MT-566T	440/2200	435
4— 100	G.E.	MT-566T	440/2300	425
2— 100	G.E.	IM-16	2200	435
2— 100	G.E.	IM	440	600
3— 100	Al. Ch.	AK	2200	1200

SQUIRREL CAGE

1—1750	G.E.	KF	4160/6900	900
2— 450	Whse.	CB	2300/4150	854
1— 200	G.E.	IK	550	585
1— 200	G.E.	KT-557	440	1800
1— 200/112	G.E.	KF-559B8	440	1170/885
1— 125	Whse.	MS	440	685
1— 125	(New) G.E.	KF-TEFC	440	1190
1— 125	G.E.	KF-TEFC	440	2085
3— 125	Al. Ch.	ARW	2200	1750
1— 100	Al. Ch.	AR	2200	1170
1— 100	G.E.	IK-Vert.	2300	450
2— 100	G.E.	KT-543	220/440	1750
3— 75	G.E.	KT-547Y	2200	1160

SYNCHRONOUS CONDENSERS

Qu.	Kva.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse		4800	720

RE NU BILT BELYEA MOTORS

BELYEA COMPANY, INC.

43 Howell St., Jersey City 6, N. J.
Phone: Journal Square 2-3334
N. Y. Line: REctor 2-7150

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

1—5000 KW, 13,200 V, 200# Cd.
2—4000 KW, 13,800 V, 600# NEW N.C.
2—4000 KW, 4160 V, 600# NEW Cd.
2—4000 KW, 2300 V, 200# Cond.
1—3500 KW, 2300 V, 150# Cond.
1—3000 KW, 2300 V, 150# Cond.
1—2500 KW, 480 V, 150# Cond.
1—2500 KW, 550 V, 250# Cond.
2—1800 KW, 2300 V, 400# Cond.
1—1000 KW, 2300 V, 260# N.C.
1—1000 KW, 2300 V, 185# Cond.
2—1000 KW, 480 V, 185# Cond.
1— 750 KW, 2300 V, 175# Extr.
1— 750 KW, 550 V, 170# Extr.
1— 750 KW, 240 V, 150# Cond.
1— 500 KW, 2300 V, 175# Extr.
1— 150 KW, 2400 V, 130# Extr.
1— 150 KW, 2400 V, 130# N.C.
1—20,000 KW, 25 cycle

ENGINE GENERATORS

1—500 KW, 2300 V. Unit.
1—335 KW, 2300 V. Unit.
1—168 KW, 220 V. Unit.

BOILERS

2—50,000#, 300#
1—30,000#, 425#
1—35,000#, 150#
3— 750 HP, 200#
1— 550 HP, 220#
2— 500 HP, 200#
3— 500 HP, 400#
1— 418 HP, 200#
2— 400 HP, 150#

DEAERATING HEATER

1—100,000# pr. hr.

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Machy. Bldg., 140 Federal St., Boston 10, Mass.

THE BUYERS MUST BE SATISFIED—ALWAYS

SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
600	2300	G.E.	1800
550	2300	G.E.	450
450	440/220	Whse	514
300	440	Whse.	3600
250	440/220	Whse.	600
200	440	G.E.	450
188	4000/2300	G.E.	1800
150	440/220	Whse.	600
150	440/220	Whse. (2)	1800
150	440/220	G.E.	720
145	4000/2300	G.E.	1800
100	440/220	G.E.	900
100 (3)	440/220	Whse.	900
100	2200/550	G.E.	1800
80	440/220	G.E. (MTC)	900
75	2200/550	G.E.	1800

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
400	440/220	G.E.	ATI	900
300	2200/440	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
250	4000/2300	El. Mchy.	Hyn.	600
240	2300/440	G.E.	ATI	720
300	440/220	G.E.	TS	720
200	4150/2300	Whse.	G	1800
125	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

GENERATOR SETS

2—unused 25 kva, 120/280 v., 3 ph., 1200 rpm. generator dir. conn. to Waukesha 6 cyl. gas engine

CIRCUIT BREAKERS

2—2000 amp., GG E. 3 pole, 600 v., air
2—1600 amp., ITE, 3 pole, 600 v., air
3—1200 ampere, Whse., 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
650	440	G.E.	FT	3600
500	2300	Cr. Wh.	SC	1800
350	2300	G.E.	KT	1200
300	2200	G.E.	FT	3600
300	2200	G.E.	KT	1800
250	2200/440	L. Allis	OGS	1200
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	KF	720
200	2300/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
200	440/220	G.E.	IK	450
150	440/220	Whse.	CS	900
150	440/220	G.E.	IK	450
100	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	R. Brg.	1800
150 vert.	440/220	G.E.	KTF	1200
150	440/220	G.E.	IK	514
150	440/220	Whse.	CS (NEW)	900
100	2200/440	G.E.	K	1200

A. C. GENERATORS

1—320 kva, 660 rpm, 2300/440/220 V., G.E.
1—250 kva, 720 rpm, 2300/440 v., G.E.
1—225 kva, 600 rpm, 220/440 v., G.E.
1—225 kva, 720 rpm, 2300/440 v., G.E.
1—150 kva, 900 rpm, 480/240 v., G.E.
3— 75 kva, 1800 rpm. 480/240 v., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
250	230 (2)	G.E.	CD	1150
250	230 (2 new)	Cr. Wh.	CMC	1900
150	230	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	825
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—300 kw, 1200 rpm, 250 v., G.E., connected to 500 hp, 1200 rpm, 2300/440 v., synchronous
1—185 kw, 1200 rpm, 240 v., G.E., conn. to 250 hp, 1200 rpm, 440/220 v., squirrel cage
1—100 kw, 250 v., Hertner, 1200 rpm, connected to 150 hp, 2300/440 v., synchronous
1—75/90 kw, 250 V., 1200 rpm, G.E., conn. to 135 hp, 440/220 V., sq. cage
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2300/440 v., syn. motor.
1—50 kw, 250/125 V., 1200 rpm, 3-wire, G.E., conn. to 75 hp, 440/220 V., sq. cage

TRANSFORMERS 60 Cy.

3—667 kva, Whse., 33,000—2300 V.
3—333 kva, G.E., 13,200—2300 V.
3—333 kva, Whse., 2400—480/240 V., Dry
3—250 kva, G.E., 6900/13,800—220/440 V.
3—250 kva, Whse., 11,000/22,000—2300 V.
3—250 kva., Whse., 2300—208 V.
3—200 kva, Whse., 13,200—2300 V. (Inerteen)
6—150 kva, Al. Chal. 2400—240/120 v.
1—150 kva, Whse, SK, 13200-125/215 v., 3 ph
3—100 kva, Whse., 4600/2300—230/115 V.
6—100 kva, G.E., 4600/2300-230/115 v., NEW
3—100 kva, G.E., 460-115/230 v., dry, 1 ph, new
2—75 Kva, G.E., 480—240/120 v. Pyranol
3—50 kva, G.E., 480—240/120 V., Pyr

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

DIESEL ELECTRIC GENERATORS

2—G.E. (NEW) 750 KW, 2400/480 Volts. 3/60, 720 RPM

1—Westinghouse (NEW) 500 KW, 2400/480/3/60/720

3—100 KW, 440 volt 3/60/1200

Each direct connected to General Motors Diesel Engine and complete with new, modern Switchboard.

SEE THESE UNITS OPERATED UNDER FULL LOAD IN OUR PLANT.

Sundfelt Equipment Company, Inc.
220 Hudson Street, Seattle 8, Wash.

Special—Immediate Delivery

4—604 H.P. Each—B&W, forged steel sectional headers, straight tube boilers, A.S.M.E.—250 lbs. working pressure—Insured by Hartford for 250 lbs. to Dec. 31st, 1950—Also available are B&W superheaters, soot blowers, boiler trim, boiler feed pumps, feed water heaters and other size B&W sectional header boilers.

WE ONLY ADVERTISE EQUIPMENT WE OWN

HOWE BROTHERS
342 MADISON AVE.
NEW YORK 17, N. Y.
Phone — MUrray Hill 2-8562-63-64

SELLING FOR CUSTOMERS

1000 KW, 2300 volt Gen. Elec. REBUILT condensing turbine 175 S.P.
300 KW 240 V Westinghouse geared Nonsond. turbine
400 KW 480 V 1200 RPM Elliott generator with 1200/4500 gear
285 KVA 240 V Chuse Iniflow engine set.
2000 Amp. 3-pole GE Air breaker with Bus Duct.
300 & 200 KW Syn. M.G. Set with control.
H. BLANE JOHNSON & ASSOCIATES
53 W. JACKSON BLVD., CHICAGO 4, ILL.

Fitzgibbons RP-107 Firebox Type Boiler 107 H.P. Hand Fired Rating—Constructed in 1939
Price ..... **$1,500.00 F.O.B. cars**

Subject to Inspection. In Excellent Shape. Available with Oil Burning Equipment.

INDUSTRIAL EQUIPMENT COMPANY
P. O. Box 673—Telephone 6750 ORLANDO, FLORIDA

Most all units still on foundation. Many may be seen operating

TURBO. GENERATOR UNITS

3000 KW (2) GE 2300 V. Cond.
3000 KW Wghse. 3/60/600 v. Bleeder
2000 KW GE 2300 v. Cond.
1300 KW Wghse. 2300 V. (bleeder)
1250 KW (2) Al. Chal., Cond. 2300 V.
1000 KW. (2) Elliott Condensing-Bleeder 480 V.
1000 KW GE 440/220 V. (bleeder)
625 KW Al. Chal. 440/220 V. Cond.
625 KW Wghse., Cond. 2300 V.
500 KW. Wghse. Non-Cond.; 250 V 3 wire, DC.
500 KW. GE 2300 V. Non-Cond.
500 KW. GE 3/60/2400/4160 V—Murray, Cond.
300 KW Wghse. 440/220 V. Cond.
250 KVA. Al. Chal. 240/480 V. Non-Cond.
250 KVA. GE 3-60-600 V. Non-Cond.
ALSO TURBO UNITS; NON-CONDENSING & CONDENSING; from 50 KW. to 2500 KW.

BOILERS

768 HP B & W straight tube, 200#
600 HP B & W strai. tube, 160#
540 HP. Keeler, Heine type 250#
509 HP. (3) B&W Sterling 450#
438 HP B & W F-16, intregal Fur. 425#
352 HP. Keeler, cross drum 250#
323 HP Springfield cr. drm. 200#
400 HP. Erie City Heine type 200#
250 HP (2) B&W 3 drum, Type H 160#

STEAM ENGINE SETS A.C.

440/220 Volts

625 KVA El. Mchy.—Skinner, Unif.
500 KVA GE-Skinner Uniflow
450 KVA GE-Chuse 4 V.
312 KVA (2) GE-Skinner Uniflow
219 KVA GE—Ames Unif.
187 KVA Wghse.-Ames Uniflow, *Vertical*
62 KVA GE-Ames Uniflow

DIESEL UNITS A.C.

440/220 Volts

500 KVA Fairbanks Morse Model 33
300 KVA Fairbanks VA, 6 cyl.
280 KW GE 250 V. d.c.—General Motors
250 KVA (2) GE-Buckeye 8 cyl.
219 KVA (2) Wghse.-Buckeye 7 cyl.
200 KVA Fairbanks VA, 4 cyl.
106 KVA GE-Murphy 6 cyl., *Portable*
75 KVA (2) General Motors; *Portable*
225 HP. Buckeye 6 cyl. diesel engine only
ALL SIZES UP TO 1250 KVA

COMPRESSORS

850 CFM (2) 110 lbs., Chicago Pneumatic, *diesel driven*
ALSO ALL SIZES 150 CFM to 1000 CFM.

PUMPS (Motor & Turbine Driven)

From 200 to 2500 GPM; from 200 to 2500' hds.
TRANSFORMERS—MOTOR GENERATOR SETS

Above listed units are only a few of our "SPECIALS". Advise your plant requirements.

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt St.
New York, N. Y.

MOTORS • GENERATORS • TRANSFORMERS

200 KW M.G. SET

200 KW Westinghouse NEMA Frame Generator 250 V. DC 1200 RPM direct Connected to
300 HP. Westinghouse Synchronous Motor 3/60 220/440 Volts 1200 RPM.
AC & DC Panels—Like new. Ship now.

1—400 KW Westinghouse 500 V. DC 750 RPM 800 Amps. Motor—580 HP. Synchronous 3 Ph. 25 cycle 440 V. 750 RPM.

ANODIZING M.G. SET

33 KW Gen. Elect. Type BR. Form C 60 V. DC. Direct connected to 50 HP. 3/60/440/1800 Gen. Elect. Motor.

600 HP REDUCER

1—600 HP Farrel-Birmingham Herringbone Gear Unit. Type SL Size 30/16 Speed 730 RPM to 115 RPM.

25 CYCLE TRANSFORMERS

3—1667 Wagner transformers. 1 Phase 25 cycle 23000 Volts primary. 575 Volts secondary.

MOTORS

60-50-25 Cycle in Stock—All Sizes
Slip Ring—Squirrel Cage—Synchronous
All types of Control Equipment.

ALL ITEMS IN STOCK FOR IMMEDIATE SHIPMENT

NIAGARA TRANSFORMERS

1 Phase — 60 Cycle — New

Stock Shipment on sizes listed. Short delivery on sizes up to 5000 KVA—1 or 3 phase, in voltage ratings to 69 KV. Standard taps. Built to A.I.E.E. —N.E.M.A.—A.S.A. Standards.

LISTING OF TRANSFORMERS

Quantity	KVA	Primary	Secondary
3	15	7200/12470Y	240/480
3	15	2400/4160Y	240/480
3	25	2400/4160Y	120/240
6	25	2400/4160Y	240/480
3	25	7200/12470Y	240/480
3	37½	2400/4160Y	120/240
3	37½	2400/4160Y	240/480
6	50	2400/4160Y	240/480
3	75	2400/4160Y	240/480
3	167	2400/4160Y	240/480
3	167	2400/4160Y	120/240
3	250	2400/4160Y	240/480

ERIE ELECTRIC CO., INC. 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

NO YOU CAN'T BEAT GLOW FOR RELIABLE ELECTRICAL EQUIPMENT

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Westgh
400	1200	440	G.E.
300	900	440	GE-I-17
250	1200	440	GE-KTR
250	600	2300	Triumph
225	514	440	GE-I-14
200	600	440	Westgh-CH
150	1800	440	Howell-SC
150	900	440	Allis-Chalmers
150	600	2200	GE
125	3600	220/440	ALCh.AN
125	1800	220/440	ALCh.AB
125	340	220	ALCh.

FREQUENCY CHANGERS

Output KW	Output Volts	Input Volts	Make
2000	2200	2300	GK
1100	250	Any	GE-HCC
100	2300	375	Wtg.
35	220	115	GE
20*	220	220	Delco
15**	220	220	GE
10**	220	550/220	GE

*60/180 cycles—**60/240 cycles

MOTOR GENERATOR SETS

KW	DC Volts	HP	AC Volts	Make
1800	250	2500	4000	GE
750	240	1100	2300	GE
400	250	600	220/440	GE
300	250	443	440	GE-EM
200	250	300	440	GE
150	250	225	440	C-W-EM
100	275	150	440	Wtg.
75	125	115	440	GE
50	125	100	2300	ALCh.
25	125	50	440	GE
35	230	40	220	Reliance-GE
20	250	30	220	GE

SYNCHRONOUS MOTORS

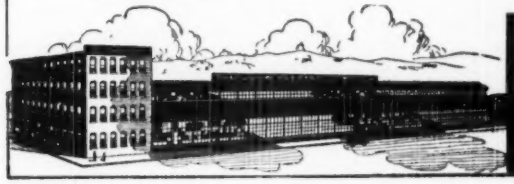
HP	RPM	Volts	Make
3000	720	4800	Wtg.
1015	500	2200	Wtg-25 cycle
500	514	440	GE
435	720	2300	GE type ATI
320	900	2300	GE-ATI
250	1800	2300/4160	GE-ATI
250	225	2300	GE-TS
225	900	4160	GE-ATI
220	600	2300	GE-ATI
175	225	220	GE-TS (rotor & stator only
160	600	440	GE-ATI
160	164	480	GE-TRF (rotor & stator only
150	1800	2200	GE
150	1800	220	GE-ATI, single bearing
150	900	440	Star
150	720	440	Westgh

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Brg.
400	1200	2300	Al. Ch.
375	1800	2300	Al. Ch.
350	600	440	Al. Ch.
350	514	440	G.E.
300	720	2300	Al. Ch.
250*	600	440	G.E.
250	300	2300	Al. Ch.
200	1800	440	Al. Ch.
200	600	440	Al. Ch.
150	1750	440	GE-MT
150	900	2200	Al. Ch.
150	720	440	Al. Ch.
150	600	440	Al. Ch.
100	1200	550	Westgh.-CW
100	720	440	Al. Ch.
100	600	440	W-E-118
75	720	440	Al. Ch.
60	600	440	Al. Ch.

GLOW ELECTRIC CO., for over 44 years, has done engineered rebuilding of electrical equipment to assure you of quality and dependability.

We invite your inquiries.



GLOW ELECTRIC CO.

927 HARRIET ST. CINCINNATI 3, OHIO
PHONE MAIN 3024

MOTORS - M. G. SETS - COMPRESSORS, ETC.

FAST SHIPMENT

MOTOR GENERATOR SETS
3 ph. 60 cy.

KW	MAKE	RPM	D.C. VOLTS	A.C. VOLTS
500	Cr. Wh.	720	250	2300
300	West.	1200	550	4000/2300
240	G.E.	1200	250	4000/2300
200	G.E.	1200	250	4000/2300
200 (2)	G.E.	720	250	2300/440
150	West.	1200	125	2300/440
150	Ridg.	900	250	2300
100	G.E.	1200	250	2300/440
100	Ridg.	1200	250	2300/440
75	West.	900	75	440/220
50	G.E.	1200	250	440/220
35	G.E.	1800	125	440/220

Also Smaller Units In Stock

ROTARY CONVERTERS

KW	MAKE	RPM	D.C. VOLTS	A.C. VOLTS
300	G.E.	600	250	4000/2300
150	G.E.	1200	250	4000/2300

Other sizes available

AIR COMPRESSORS
1575 CFM, 100#, PRE2 Ing. Rd. direct conn. to 265 HP, 2300 v. syn. motor.
741 CFM, 100#, OCB, Chg. Pn. belted 150 HP motor.
2—500 CFM, 100#, Allis Rotary direct connected 100 HP S.B. Motors.

A.C. MOTORS—3 Ph. 60 Cy.

HP	MAKE	RPM	TYPE
500	G.E.	450	MT412—Sl.Rg.
350	West.	600	CW1106—Sl.Rg.
300	G.E.	450	IM—Sl.Rg.
200	G.E.	1200	MI—Sl.Rg.
160	G.E.	600	IK-16—Sq. Cg.
150	West.	514	CS954—Sq. Cg.
150	G.E.	600	ATI—Syn.
125 (3)	Allis	900	ARY—Sq. Cg.
100 (3)	Allis	720	ARX—Sq. Cg.
100 (5)	West.	1200	CS752C—Sq. Cg.
100 (2)	G.E.	450	IM16—Sl.Rg.
75	West.	900	M5342 Sq. Cg.
75	G.E.	600	ITC5013A
50/12.5	G.E.	900/450	IM 2200 v.
40	G.E.	1200	MT336—Sl.Rg.

Also Smaller Units In Stock

D.C. ADJUSTABLE SPEED MOTORS
250 Volts

HP	MAKE	SPEED	TYPE
375	West.	430/860	Ped.
200	West.	400/800	SK210
150	West.	400/800	SK201
125	West.	450/1000	SK193
60	West.	435/870	SK185
50 (2)	Elec. Dyn.	190/760	

Also Smaller Units In Stock

Send us your inquiries for any POWER EQUIPMENT you may require.

MOORHEAD ELECTRICAL MACHINERY COMPANY
361 Noblestown Road Oakdale, Penna. Pittsburgh District

AIR COMPRESSOR
3000 cfm @ 110 psi

Ingersoll Rand Type PRE-2, 30 x 18 x 21. Direct Connected to 500 HP G.E. Synch. Motor, 3/60/2200V Excitation & Panel

USED ONLY 6 MONTHS

HEAT AND POWER CO., INC.
70 PINE ST. DIGBY 8-0373 NEW YORK 5

ONE STEAM POWER PLANT
2000 K.W. 3 PHASE 50 CYCLES 6300 V.
EIGHT (8) TURBO-GENERATORS:

Four (4)—250 KW A.C. plus 40 KW D.C. 250/450 V 3 phase, 60 cycle or 200 KW plus 30 KW D.C. 220/380 V—50 cycle Mfg. by General Electric Co.

Two (2)—300 KW D.C. 120/240 volt 6 Pole—3 wire—Comp. Wound Turbine by Worthington Moore. Generator—Allis-Chalmers.

Two (2)—300 KW D.C. 120/240 volts. Comp. Wound Turbine by J. Hendy. Generator—Westinghouse.

Packed for Export in Original Crates

Complete Specifications and Details Upon Request

International Fermont Machinery Co., Inc.
115 BROADWAY NEW YORK 6, N. Y.

FOR SALE

Skinner Slide Valve Engine, 13¼x16 direct connected to 125 KVA, 240 volt alternator with belt driven excitor, 135 psi.

Lane & Bodley corliss engine, 16x42, 135 psi.

RANNEY REFRIGERATOR COMPANY
Greenville, Michigan

FOR SALE

One Dean of Holyoke Underwriter Duplex Steam Pump 16x9x20; Capacity—750 g.p.m. One Tandem Compound Corliss Steam Engine, Hewes and Phillips, 12 x 26 x 36 with Blake and Knowels jet condenser. Flywheel dia. 12 ft. face 42½".
Write:—Mr. Amos N. Prescott, Sr., J. L. Prescott Co., 27—8th St., Passaic, N. J. or call Prescott 7-4200.

FOR SALE

3 used I-R; 12x12x12 duplex double acting imporial type 10; 250 RPM 50 lb. belt driven air compressors belt wheel 3 ft. diameter.

1 Used D.C. Motor 65 HP 110 v. compound wound, 500 RPM, newly reconditioned.

FS-7139, POWER
330 W. 42nd St., New York 18, N. Y.

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WANTED TO BUY
For Cash

YOUR SURPLUS
ELECTRIC MOTORS
MOTOR STARTERS
OIL & AIR CIRCUIT BREAKERS
CABLE-WIRING MATERIALS
PANEL BOARD FITTINGS
SPEED REDUCERS
COPPER WIRE

INDUSTRIAL ELECTRIC & SUPPLY CO., INC.
37-1681—Memphis, Tenn.—Box 1398

Air Compressors Wanted
Horizontal Water Cooled—Any size also 2 Stage portable unit

L. W. BAUER
North Bergen, N. J.

BUYERS OF SURPLUS COPPER INSULATED WIRES AND CABLES
No lengths too long or too short
TELEPHONE: EASTGATE 7-4778
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"Seachlight" Advertising

MOTORS—M.G. SETS—TRANSFORMERS

SQUIRREL CAGE MOTORS
3-Ph., 60-Cy.

Qu.	HP	Make	Type	Volts	RPM
1	400	G.E.	IK	2300	514
1	400	G.E.	KT-412	2300	450
1	400	G.E.	KT-412	550	450
1	300	Al. Ch.	AB	440	1760
1	250	Whse.	CS	2200	1160
1	200	Al. Ch.	AB	220/440	580
2	125	Al. Ch.	AB	2200	1750
1	125	Whse.	CS-781	440	1750
1	125	Whse.	CS-772	2200	1170
2	125	C.W.	1260	440	450
3	100	Whse.	CS-863	440	1750
1	100	Al. Ch.	AB-226	2200	1160
1	100	G.E.	KT-556	2200	865
5	100	F.M.	H8-201C	440	880
1	100	Al. Ch.	AB	550	690
1	100	Al. Ch.	AB	440	575
1	100	F.M.	H-241B	440	450
1	100	Whse.	CS-938	2200	514
1	100	Al. Ch.	AB	440	695
1	78	G.E.	I-15-K	220	570
2	75	Al. Ch.	AB	2200	1765
1	75	Whse.	CS	440	1750

SYNCHRONOUS MOTORS
3-Ph., 60-Cy.

Qu.	HP	Make	P.F.%	Volts	RPM
1	450	G.E.	80	440	360
1	400	Whse.	80	440	600
1	268	Al.Ch.	100	2200	900
2	250	Al.Ch.	80	2200	514
1	200	Whse.	80	440	300
1	150	G.E.	100	2200	900
1	150	G.E.	80	550	450
1	150	Whse.	100	2200	400
3	125	El. Mch.	100	4800	900
1	125	G.E.	80	2200	900
3	100	Whse.	80	440	1800
1	100	Ideal	80	440	900
1	100	Whse.	100	2200	1200
2	100	G.E.	80	440	600

SLIP RING MOTORS—CONSTANT DUTY—3-Ph., 60-Cy.

Qu.	HP	Make	Type	Volts	RPM
1	2000	G.E.	MT	2200	356
1**	2000	G.E.	MT-30	2300	240
1**	1500	Al. Ch.	ANY	2200	230
1**	1200	Cr. Wh.		2200	257
2**	1000	Al. Ch.	ANY	2300	235
2	1000	Whse.	CW	2200	444
1**	800	G.E.	MT-12	6600/2200	300
1**	600	G.E.	MT-412	2200	710
2	500	G.E.	I-16-M	2200	450
1***	400	G.E.	MT-574	550	585
1	400	G.E.	I-E17-M	2300	875
1**	400	G.E.	I-M	2300	300
1**	400	Al. Ch.	ANY	2200	505
2	400	G.E.	MT-412	2200	440
1	300	G.E.	I-E15-M	2200	1200
1	200	Al. Ch.	ABY	2200	505
1	250	Al. Ch.	ABY	440	440
1	250	Whse.	CW-1106	2200	580
1	250	Whse.	C W.	550	514
1	250	G.E.	MT-414	2200	300
1	150	G.E.	I-E13 M	2200	1750
1***	125	Whse.	C W.-870	2200	900
1	100	Al. Ch.	ABY	440	1160
1	100	F.M.	129-C	440	900
1	75	G.E.	I.M.	440	695
1	50	G.E.	MT-536	2200	1150
1	50	Al. Ch.	ABY	440	850

—Mill type pedestal bearing. *—3-bearing.

TRANSFORMERS—(OIL COOLED)

Qu.	K.V.A.	Make	Type	Ph.	Volt
2	4500	G.E.	HT	3	27000/13500/2300
3	500	G.E.	H	1	13200/11880/220/440
3	200	Pitts.	OISC	1	14400/12600/220/440
3	150	Pitts.	OISC	1	33000/22000/2300/4600
2	150	G.E.	H	1	19000/2500/550/2200
3	100	Whse.	S8	1	12675/10955/230/460
3	100	G.E.	H-KF	1	4160/120/240
3	75	G.E.	H-KF	1	2400/4160Y/120/240
3	50	Al. Ch.	OISC	1	2200/220

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	VOLTS DC	VOLTS AC
2	1500	G.E.	600	600	4160/2300
1	1250	Al. Ch.	720	525	4800/2400
2	1000	G.E.	514	575	4000/2300
1	600	Al. Ch.	720	525	2200/440
1	500	Al. Ch.	730	525	2200/440
1	200	Ridgeway	900	275	2300
1	155	G.E.	720	250	2200/440
2	150	C.W.	900	250	2200/440
1	100	Ridgeway	1200	275	4000/2300
1	100	Delco	1200	120/240	2300/460
1	75	Whse.	900	275	2200
1	75	Al. Ch.	900	250	2300
1	75	Star	1200	250	440/220
2	75	Reliance	1750	250	440/220
1	56	Reliance	1750	250	440/220
(4 Units Variable Voltage Set with 5-K.W. Exciter)					
1	35	G.E.	1750	125	440/220
1	30	Reliance	1750	250	440/220
2	25	Whse.	1200	120/240	440/220
1	9	G.E.	1750	250	440/220

Available for inspection as its original foundation (1) 1500-KW Westinghouse M-G Set, 250-VDC, 514 R.P.M., comp. interpole; 2150-HP, syn. motor, .80 P.F., 514 R.P.M., 4800 Volt, 3-ph., 60-cy (will reconnect for 2300-V), with complete DC and AC panels and reduced voltage starting equipment for syn motor.

DIRECT CURRENT MOTORS

Qu.	HP	Make	Type	RPM
4	1300	Whse.	Encl.	600
2***	1250	Whse.	Mill	300/600
6***	800	Whse.	Encl.	600
1	400	Al.Ch.		400/1200
1	400	G.E.	MCF-4	200/600
1***	350	G.E.	CD-169	1150
1	350	G.E.	QM	450/900
1	325	Whse.	QM	400/1200
1	200/250	El.Dy.	F-22	300/1200
1	200	Whse.	Mill	400
1	180	G.E.	MFC	400/1200
1	150	Al.Ch.	Mill	880
2*	150	Cr.Wh.	80-H	300/1200
1	100/125	Rel.	1093-T	400/1200
2	100	Rel.	1050-T	625/1125
1	90/160	G.E.	MFC-6	300/1200
1	75	Whse.	SK-151L	300/1200
1*	50/75	Rel.	1093-F	400/1200
1*	30/75	Whse.	SK-151L	300/1200
1	50	Whse.	SK	500/1500
2	35	G.E.	BF-14	480/1200
1	32½	Whse.	SK-150	400/1200
1	30	Al.Ch.	E-145	875/1750
1	30	G.E.	SDM-105	450/1350
2	27½	El.Dy.	13-S	

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*** are 525/600-VDC pedestal bearing mill type
*—T.E.F.C.

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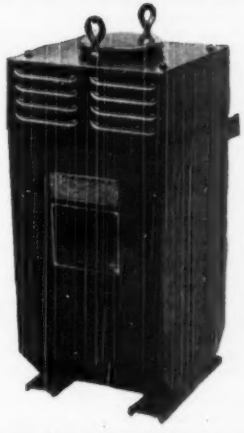

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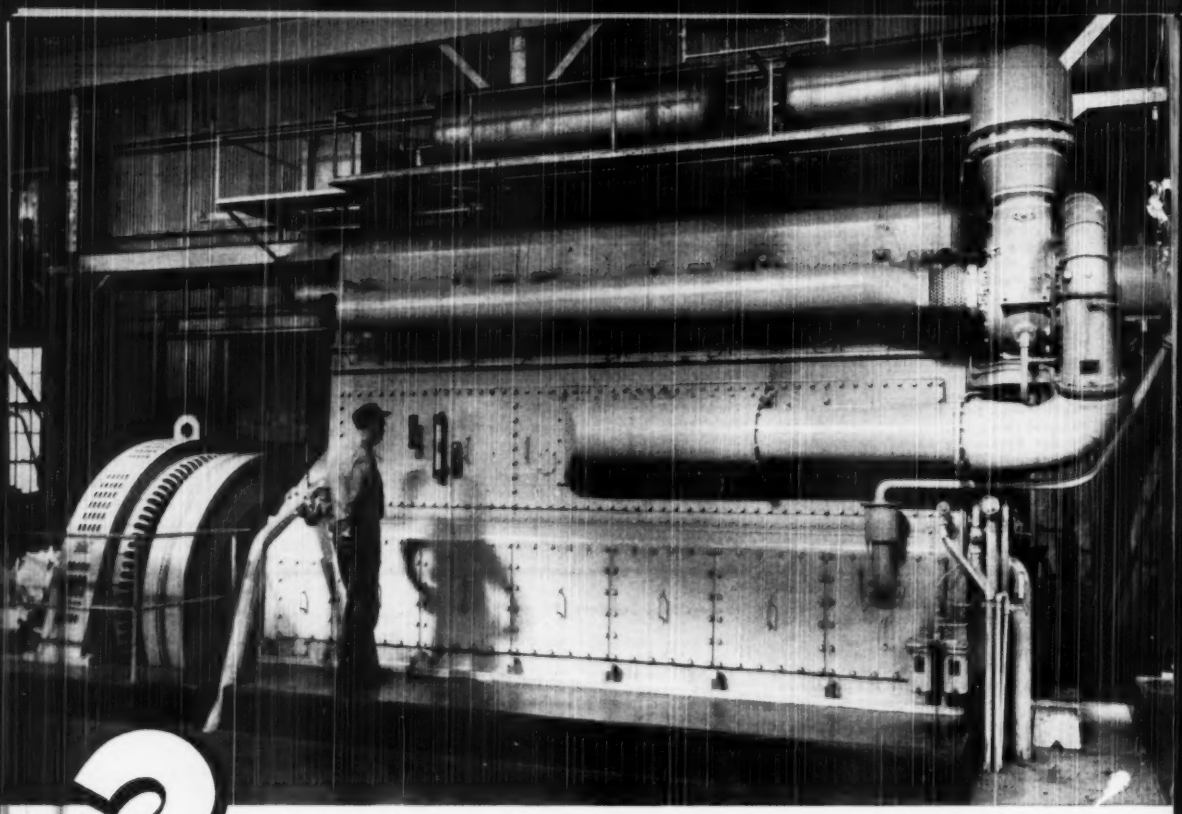

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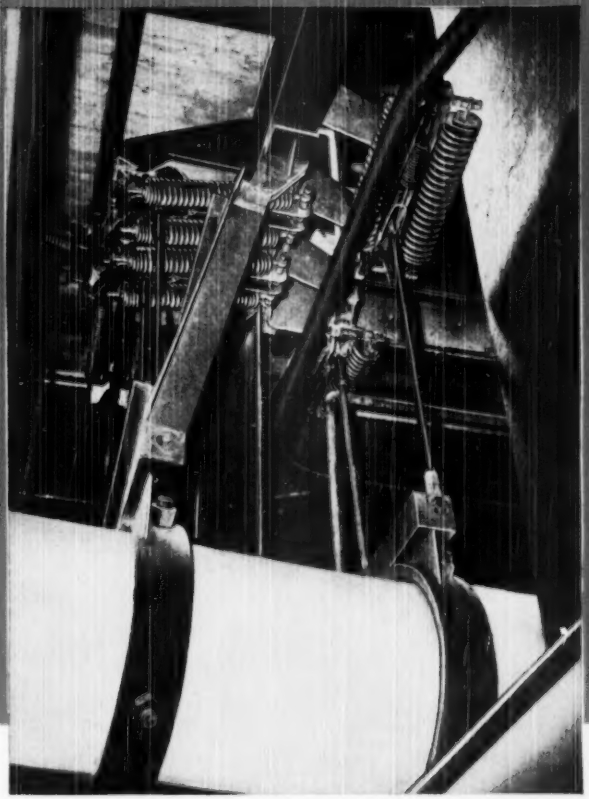

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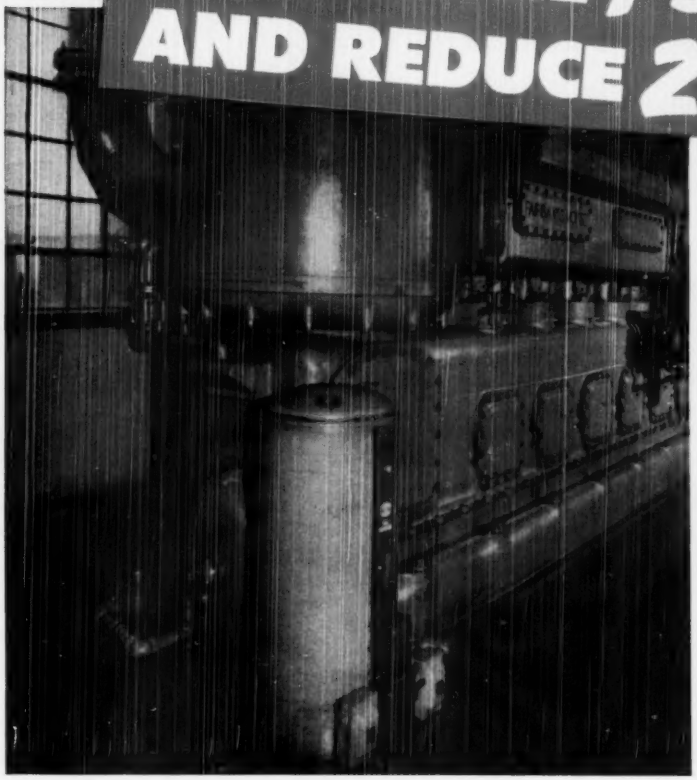

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